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The Welsh Engineers' and Founders' Association
The Foundry Trades' Equipment and Supplies Association

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First Fruits

The issue of Control of Iron and Steel Order No. 6, dated January 29, details of which were given in our issue of February 1, is an outstanding event for the foundry trade and marks the first fruits of the work of the Ironfounders' National Committee. This Committee, as is now well known, was established at York on September 15 last as a result of movements which took place before the outbreak of war, but when it appeared inevitable. In view of the need for immediate action an executive was formed. This group was criticised as non-representative, particularly in view of the need for representing small foundries. Since that time, however, the I.N.C. has steadily proceeded to put itself on a representative basis and is at present a body of about twenty comprising the leading producers and associations in the trade. This is still going on, and when a formal constitution is established it will doubtless be found that full provision is made for the co-operation of all sections of the industry, both grey and malleable.

In the meantime, the congratulations of the industry are due to the Committee for what has been accomplished in the comparatively short space of five months, for originally a serious situation had to be faced. The ironfounding industry, with a throughput of some two million tons of castings per annum, a turnover of some forty million pounds, and a labour force of a hundred thousand men, found itself at the outbreak of war controlled by the Government through the Ministry of Supply as part of the Iron and Steel Control. This Control is essentially one of raw materials and covers only those castings, grey and malleable, which have been subjected to moulding, fettling, annealing, and painting. Much peacetime work disappeared and the prices of certain essential materials began to rise, and supply difficulties caused a certain shortage. Pig-iron and scrap were also controlled. The founder thus no longer had a free market in raw material or product, and a host of problems arising out of the Control required solution. Some authoritative channel through which these problems could be discussed with the Control on behalf of the industry was essential, and this the I.N.C. became, as apparently the other employers' associations felt their organisation inadequate for the task envisaged.

Founders, like other business men, remembering the last war, are among the last to want to see prices rocketing or dependent purely on supply and demand. They want to see prices kept down, and to see the industry play its part in the national effort, and they clearly cannot afford to continue to lose money. The new Order assists the first and last of these. The only increase permitted prior to the present Order was 10s. per ton to offset the rise in pig-iron. This is now increased to 13s. 4d., and a maximum of 8 per cent. on the pre-war price may be added to cover increases in production costs. Finally, further additions may be made for alloy castings dependent on the amount of alloy present and the rise in price of the ferro-alloy or metal concerned. In some foundries the rise in costs is below 8 per cent., while in others it is more. Time has not permitted the industry to be sectionalised, but there is rough justice in an addition common to all foundries, because a considerable proportion of the cost increases, such as provision for A.R.P., has been common to all foundries.

The next main task of the I.N.C. is to ensure the fullest use of the industry in the country's war effort, and this calls for a vigorous policy for the extended use of cast-iron. The pressure on the production of steel, non-ferrous metals and concrete, and the conservation of timber, all underline this as nationally desirable. The substitution of cast iron for other materials, however desirable in principle, calls for most careful consideration in individual cases, and this matter the I.N.C. has well in hand.

We only echo opinion in the industry in saying that the formation of the I.N.C. was a sound and far-sighted move. It deserves the goodwill and encouragement of the whole industry for what it has already accomplished, and this in itself is evidence that it has the goodwill of the Control and the authorities.

Non-Ferrous Scrap Situation

BY "ONLOOKER."

When on December 18 last the issue of Ministry of Supply Order No. 5 gave effect to an all-round price advance in copper, lead and spelter of approximately £10, the values of non-ferrous scrap were moved up in a similar manner. Holders of old metal thus received a pleasant Christmas box in the shape of an appreciation in value which many of them had been anticipating for months. The change in values was decidedly spectacular, and certainly justified the policy adopted by many people of accumulating all they could with a view to securing a handsome profit, when, as it was contended would be the case, the Ministry of Supply was compelled to put up prices.

Since Christmas there has been a more satisfactory flow of old metals, but some difficulties still exist, although in a number of cases these are being smoothed out. It should be noted that under the revised schedule of old metal prices, maximum quotations are given on an "ex-works" basis, so that unless the consumer knows where the material he has purchased is lying, there must be doubt in his mind about the total all-in cost of the parcel. However, the seller is certainly entitled to add the cost of carriage to the official maximum price, and there would not appear to be anything to prevent the merchant or dealer from asking also for an allowance to cover the cost of sorting and grading the material if such a course is necessary. Packing, if required, may also be added to the official maximum price.

Recurrence of Hoarding?

As already stated, the higher values have been instrumental in persuading holders of scrap to release metal for consumption by manufacturers, but what is not yet clear is whether the hoarding policy has again begun. Those competent to judge believe that at present the volume of metal being held back is negligible, but of course there is no guarantee that in due course the old symptoms will not develop again and result in a hold-up of essential supplies. Probably manufacturers of brass products are getting back from their customers direct considerable quantities of scrap, a fact which, although it is far from helpful to the merchants, certainly suits the present situation well enough.

In these days of control and fixed maximum prices, it is not easy for the middleman to earn a living, but as far as the scrap trade is concerned it would obviously be disastrous were these experienced members of the business community to be forced to close down. The point is, how are the scrap metal merchants to be kept in the picture so that their knowledge may be harnessed to the task of distributing the scrap to the best possible advantage in bringing the present war to a successful conclusion?

An Instance of Price Decontrol

It will be remembered that before the end of last year a decision was reached to decontrol aluminium and aluminium-alloy scrap, this change of plan coinciding with an increase in the price of the virgin metal to £110. There was, of course, an immediate rise in values, but a fair margin was left between secondary and primary metal, although recently there have been indications that the prices put upon scrap are increasing unduly. From time to time since the war began it has been suggested that the control on the prices of brass and copper scrap should be allowed to lapse, but it is hard to believe that such a course is one that should be pursued in existing circumstances.

Catalogues Received

Moulding Box Plant. A very high standard in trade publicity has been reached by Sterling Foundry Specialties, Limited, of Sterling Works, Bedford, in their latest catalogue. For the cover they have used thick grey cardboard backs with the name Sterling picked out in embossed gold letters edged with blue. The binding is carried out with a wire spiral. Though the reviewer is very familiar with Sterling boxes, it was a matter of some surprise to him to learn of the very large number of designs and sizes which have been standardised. Yet this factor of standardisation has not been made a fetish with the firm, as on pages 36 to 40 about a dozen types of special-purpose boxes are illustrated, the largest being 5 ft. 6 in. by 8 ft. From the metallurgical aspect, it is interesting to note that nowadays a higher carbon, copper-bearing steel is being used. This must be of benefit especially where dry-sand moulding is being practised. Pages 41 to 47 contain a series of very interesting photographs of the interiors of modern foundries, and quite a few lessons on mould handling problems! Lugs, pins and bushes are subjects of major importance in the production of modern repetition castings, and the nine pages devoted to their consideration are by no means excessive. If the foundryman can obviate this trouble by purchase instead of using home-made contraptions, he would be well advised to follow this principle. The final pages contain information on such subjects as the insertion of bars in Sterling boxes, steel upsets, jackets, slotted pins and cotters, clamps (a very neat design is shown), steel bottom boards, core plates and pattern plates. The only suggestion which the reviewer has to make for the improvement of this excellent catalogue is the captioning of the internal views of the foundries. The brochure, which contains 64 well-illustrated pages, is available to our readers on writing to Bedford.

Lubrication. A folder just issued by E. G. Acheson, Limited, of Thames House, Millbank, London, S.W.1, dealing with "Aquadag"—that is, colloidal graphite in water, carries an interesting section on the use of this material for coating the dies used in the making of die-castings. It would be interesting to learn whether there was any experience available as to the use of "Aquadag" for the surface protection of chills as used in ironfoundry practice. A number of other applications are dealt with in this folder, which is available to our readers on writing to Thames House.

Welding Rods and their Applications. An exceedingly useful 32-page brochure has been sent to us by I.C.I. Metals, Limited, Kynoch Works, Witton, Birmingham, 6, dealing with the application of welding rods. The main ground covered is the non-ferrous field, but not entirely so, as certain bronze rods are used for welding cast iron. The technique of welding is particularly clearly described by the use of a multitude of sketches and pictures. The inclusion of an index is thoroughly commendable and worth emulation by other concerns publishing similar brochures. The brochure is available to our readers on writing to Witton.

Publication Received

"War Savings." Published by the National Savings Press Office, Bouverie House, Fleet Street, London, E.C.4.

This sixteen-page magazine is the first of a series which is to be published with the object of fostering interest in the War Savings movement. This first issue is of distinct interest as it provides the fundamental information required for a knowledge and appreciation of the effort that is now being made. Those firms which have not yet started a group will receive full information by writing to the publishers.

Random Shots

An interesting story of the arctic weather experienced last week comes from the Midlands. A corner of the moulding shop in the foundry of Chamberlin & Hill, the Walsall firm, was transformed for a short period into a lambing pen. The foundry backs on to a field in which there were twenty in-lamb ewes. As the snow fell thicker and thicker the ewes became slowly enveloped, until it seemed that they would be completely buried. To save this oncoming disaster the sheep were taken into the foundry, where a pen was made for them out of roofing sheets and moulding boxes. The head fettler was then elected shepherd-in-chief, and to quote the words of the director, "the first lamb was produced in the early morning, and no patterns or other equipments were needed."

* * *

"Peterborough" of the "Daily Telegraph" tells a story which will produce a smile (one hopes it will be good-natured rather than sarcastic!) in many a managerial office.

Scene. A new Ministry.

Time. Saturday morning.

New Ministry (on the telephone): What is the position of the —— contract?

Firm: It's rather complicated. Will it do if I ring you first thing on Monday morning?

New Ministry: Good heavens, man! Don't you realise we are at war?

Firm: All right, I'll go into it right away and 'phone you back later.

New Ministry: Yes, please do. By the way, ring me before mid-day. We close at twelve on Saturdays.

* * *

It appears that in Germany ladies' dresses are the latest things to be standardised, and they will be produced in three colours only, black, red, or brown. Zo! the Nazis still haven't the courage to order universal "wearing of the red" and still cling indecisively to the Brown and the Black skirt!

* * *

There is also a report that Germany is now producing an ersatz iron, which is a "kind of metal fibre, manufactured from the elements of coal and lime." It has, it is claimed, great elasticity, and is practically immune from wear and tear and deterioration. How many Germans once had the same high hopes of Nazism!

* * *

Whilst one is accustomed to hearing general habits of living expounded as the answer to the question, "To what do you attribute your old age?," it has not yet been on record that anyone has ever attributed his old age to working in a foundry. Yet, looking at "The Week's News in Brief" in almost any issue of this JOURNAL, it rather looks as if it would be a very justifiable answer. The average expectation of life seems to be about 75, well over the allotted span.

* * *

Long service with one firm also seems to run in the foundry industry, for one frequently finds such records as (to take last week's column alone) 30 years' service, 40 years, 59½ years, and even 60 years! Nice work if you can get it, as the saying goes.

"MARKSMAN."

RUSTON & HORNSBY, LIMITED, Lincoln, have acquired the whole of the share capital of Davey Paxman & Company (Colchester), Limited, the well-known oil-engine builders and boiler manufacturers. The business will be continued as heretofore, under the managing directorship of Mr. E. P. Paxman. The objective is to enlarge the joint range of manufactures to the mutual advantage of both businesses.

Synthetic Moulding Sand

DISCUSSION OF MR. A. TIPPER'S PAPER AT DERBY

MR. A. TIPPER'S Paper on "Synthetic Moulding Sand" (printed in our columns last week) led to an informative discussion on modern sand practice when it was presented to the East Midlands Branch of the Institute of British Foundrymen, meeting in the messroom of Ley's Malleable Castings Company, Derby.

Preventing Loss of Moisture

MR. R. H. BUCKLAND (Branch-President) pointed out that founders in this country were fortunate in having available very large sources of natural moulding sand, the lack of which caused America to develop synthetic sand mixtures. Mr. Tipper had emphasised the permeability of the silica sand. The question of loss of moisture had to be considered, and several antidotes for this trouble had been mentioned, one being the addition of glycerine. Mr. Buckland asked how the glycerine was added to the mixture.

Although definite figures had not been given, it appeared to him that the initial cost of introducing the synthetic sand was considerable, but he believed that once a foundry had been started using synthetic sand entirely, the cost of new sand compared favourably with that of natural moulding sand mixtures. Could Mr Tipper give some figures relating to comparative costs?

MR. TIPPER said that two or three years ago the number of foundries using synthetic sand was small, but he knew himself of twenty or thirty foundries in the Midlands which were using some form of synthetic sand. They were discontinuing the use of large additions of natural bonding sand and were making small additions of glue, to keep up the properties. He thought there were about 3,000 foundries in this country, and not only the iron foundries but the steel foundries as well to-day would be found using the synthetic sand for the green-sand and dry-sand work. They might be using just the same basic sand that they started with.

The glycerine was dissolved in the water which was being added to the sand. Mixing glycerine with an equal amount of water gave a good solution.

Clay Additions

In some cases the clay was added as a liquid. It had been suggested that the best method of adding the clay was to mix it up thoroughly, making a smooth cream with water, and to add it to the sand in that way. If 1 per cent. of clay was being added, about ten times the amount of water would be required to go with the clay, which would therefore increase the moisture content above the amount required. It could be used in some particular cases.

As to the cost of the actual conditions, said Mr. Tipper, this would work out at just about the same in one case, and half the cost in another. Comparing a large system of synthetic sand with a natural bond system, they were both very economical. In one case the figure was about 10s. per ton for the natural bond sand and about 9s. per ton for the synthetic sand. Most natural-bonded sand systems worked on at least 10 per cent. additions.

If a new foundry was being started up with new sand, it would cost much money. The difference in cost was, say, 6s. per ton and 12s. per ton. That was double, certainly, but once started one could go on indefinitely, providing a make-up sand of the right grading was selected, and if one was in the fortunate position of having a core shop where the core sand could be controlled to make an addition to the floor sand, then the cost of new sand could be eliminated altogether.

MR. H. L. SANDERS expressed interest in Mr. Tipper's figures, which represented a tremendous amount of work. He referred to one graph where the permeability dropped as the number of blows of the A.F.A. rammer was increased from 3 to 21, and the ramming density was stated to be constant at 1.45. Surely this was an error, as the ramming density would increase with the number of blows. Mr. Sanders asked for more information about the organic binders, and particularly how tar was added, as this appeared to be rather a problem.

Commenting on synthetic sands, it was acknowledged that the bond was different from that of a natural sand, in that it was more closely held in a natural sand. Would Mr. Tipper give his opinion on this point?

Another matter was the use of old cores in the mix. They had oil in them, which made the cores hard, and it would be an expensive proposition to burn the oil out to make the sand suitable for incorporating in the new mix.

Organic Binders

MR. TIPPER said the organic binders were well worth considering, particularly if, say, working with a sand that had its best properties reduced at rather high moisture content, because moulders probably found it heavy going. He knew of one foundry, engaged on non-ferrous work, which had trouble because the moulders were unable to sieve their sand quickly; by a small alteration, reducing the actual bonding sand and substituting the addition of 1 per cent. of a liquid bond, they were able to develop sufficient plasticity and get much faster moulding results.

At the present time there might be occasional difficulties in procuring all materials, but if the type of mixture and the properties required were decided upon, then, if a few tests were made, it was simple to find an efficient mixture. If the sand coming back from the mill was working satisfactorily, and not causing trouble through scab castings, it could be said that the sand had sufficient strength and was working correctly.

For tar additions to sand, a thin tar of the creosote type could be obtained, which could be added when thinned down with oil or paraffin. Difficulty was experienced when mixing many oils with water. To his knowledge, the method was not used in this country, but in the U.S.A.

Differences in Bond

An explanation of the difference in bond, he said, would require more than his knowledge, but he could suggest several reasons for the way in which the bond was retained. For example, if making a synthetic sand mixing, it lost its bonding plasticity very quickly as it dried up, and did not develop the same bond. Much depended upon the surface character of the grains. If the finished casting was satisfactory and one could get the necessary lift from the sand, then it was satisfactory. The main point was that if the sand paid and gave good results, then it was well worth exploiting.

The re-use of old cores was being effected in one or two cases. As the castings were put on one side, all the burned sand that dropped from them was separated, and the sand that was loose and fine was put into the system, but the strength was destroyed. If a very strong core was being used on thin-sectioned work, there would not be anything like the sand required.

If one wanted to use the cores without incurring much expense, a very weak mixture must be used, or the making of the core must be adjusted so that it would easily leave the casting. Then all the lumps were sieved out and rejected, only the fine sand being added to the rest of the material in the system.

MR. J. C. HALLAMORE asked whether, in Mr. Tipper's opinion, it was possible for the ordinary foundryman to change over from a natural bond to a silica sand without calling in outside help.

Transition Difficulties

MR. TIPPER replied that it entirely depended on the reason for the change as to whether it would be worth while. Noting the number of people who had gained as much knowledge as he had by their own work, if the time could be spared to go through the various Papers that had been given on the subject, all the necessary information could then be obtained. The major factor was whether the foundry contemplating a change-over had the equipment and would back its own judgment. Finally, there was the human element to contend with, and much prejudice against the use of synthetic sand existed.

MR. A. BILL suggested that Mr. Tipper's remarks were not very clear as to why one should change over to synthetic sand. Was it because it was cheaper, or because it was easier to prepare? Could it be said that the castings were definitely better, with fewer wasters and better finish, than when using naturally-bonded sands? He believed Mr. Tipper had mentioned a certain amount of difficulty that had been experienced in actual moulding practice, which he asked him to confirm.

MR. TIPPER said he was not in the position of insisting that they should change over to synthetic sand. He wanted them all to be interested in the subject and decide for themselves. Quite a proportion of foundry wasters was caused by sand, and there was less trouble with synthetic sand. He could say that, with a properly controlled synthetic sand, the general troubles applicable to sand were less. Most of the people who had changed over to it had found a lower cost, otherwise he was quite sure they would not use it. The difficulties in moulding were those commonly experienced when adopting any new material. One had to become accustomed to its peculiarities.

MR. BILL remarked that, according to Mr. Tipper, there were definitely fewer sand troubles, *i.e.*, there were fewer wasters due to sand defects, when using synthetic sand. He asked if possibly it might not be that there was less trouble due to the synthetic sand itself. If such sand was in use, a very efficient sand preparation system was necessary, and that probably would have a good deal to do with the matter.

MR. TIPPER agreed that the control would improve conditions, irrespective of whether synthetic or natural sand was used.

Vote of Thanks

MR. BUNTING, in proposing a vote of thanks, said there was always a certain prejudice to be overcome when anything new was introduced. Some foundrymen would probably remember that it took a war to start them thinking seriously about sand! Prior to the last war it was deemed unnecessary to bother much about sand, for the simple reason that it was quite cheap, until the Government started seriously to consider the position of sand deposits in this country. From that had arisen the investigation of synthetic sand, which, in his opinion, tended towards the safeguarding of the industry when, in time, there would be a shortage of natural sand.

Whilst at present many of them knew little about synthetic sand from a practical standpoint, and had not the pluck to set about installing it, those people who had done so were getting good results. Mr. Bunting was of the opinion that the future in this country held promise of far greater use for synthetic sand than it had previously.

MR. BECK seconded the vote of thanks, which was enthusiastically accorded.

Lancashire Foundrymen's Annual Dinner

MR. D. H. WOOD STRESSES NEED FOR EXPORTS

The annual dinner of the Lancashire Branch of the Institute of British Foundrymen was held at the Grand Hotel, Manchester, on February 3, Mr. A. L. Key (Branch-President) in the chair. The chief guests were Mr. D. H. Wood (Junior Vice-President of the Institute), Mr. T. Makemson (Secretary of the Institute) and Mr. A. C. Dean, M.C., M.Sc. (President of the Manchester Association of Engineers).

The dinner was preceded by a whist drive, at which Mr. R. A. Miles and Mr. J. Masters were M.C.'s, and dancing followed dinner, Mr. F. A. Harper then officiating as M.C. Mr. R. A. Miles, social secretary, and Mr. A. Boyes, hon. secretary of the Branch, were responsible for the arrangements.

The Institute's Seal

After the Loyal Toast had been honoured, the toast of the Institute of British Foundrymen coupled with the Lancashire Branch was proposed by MR. A. C. DEAN, who described the Manchester Association of Engineers as a sister association of the Institute, stressing the friendly relations invariably existing between the two organisations. His predecessors had visited them on many occasions in the past, always with the one desire in their minds to pay tribute to the Institute and its valuable work, and to express the very best wishes to the Lancashire Branch and its President.

Mr. Dean proceeded to make humorous reference to the figures depicted in the seal of the Institute, reproduced on the menu. Reading the motto, "Science hand in hand with labour," he wondered why Labour found it necessary, so far as the Institute was concerned, to go to Science with about the largest hammer he had ever seen. (Laughter.) It might be that Science, in that case, was of the feminine sex, although the utensils with which she was surrounded did not suggest to him the domestic in any way. It might, therefore, be that Labour had taken the hammer in the ordinary way of domestic protection. (Laughter.)

His Association extended most fraternal greetings to the members of the Institute. He noticed that the Branch had about 370 local members, and it must (he added jocularly) be a source of relief to many households, now that 370 husbands had at least one evening a month they could explain away. (Laughter.)

Reserve Capacity and Export

MR. D. H. WOOD, responding to the toast, expressed appreciation of the way in which Mr. Dean had referred to the Institute. The President (Mr. W. B. Lake) had asked him to convey to the assembly his warmest regards and kindest greetings. There were many reasons why it was a pleasure to visit the Lancashire Branch and to make his first appearance at its annual function. First of all, was not the Lancashire Branch the largest Branch of the Institute? Secondly, were not the headquarters of the Institute in the city of Manchester? Thirdly, had not the Lancashire Branch, at a critical stage in the history of the Institute, provided it with a Secretary? Without attempting to steal the toast of the Branch-President, to which Mr. Makemson would reply, he would like to pay his tribute to that gentleman for his efficiency, his capability and his popularity. He was extremely popular with all the members of the Institute; in fact, he was universally known, not only in the foundry industry in this country, but throughout Europe and America, as "Tom." No greater tribute could be paid to anyone than that he should be addressed in so friendly a way.

Mr. Wood assured Mr. Dean that the Institute, throughout the whole of its Branches, was carrying on with its technical work, and although some Branches had had to contend with transport difficulties, he understood that every Branch, with one exception, was carrying on, and holding its meetings regularly, and that those meetings were well attended. Some sections of the industry were overwhelmed with business; in fact, the foundries had difficulty in keeping up with demand. He referred to the steel, the malleable-iron and the non-ferrous foundries. On the other hand, there were some groups of the industry where a lack of business was being felt. A few days previously, the Prime Minister had announced in the House of Commons that there was to be a tremendous export drive, and he believed that certain industrialists who had been watching closely the course of the war were of opinion that such a drive was of vital importance to the country. In fact, it was probably only second to the supply of armaments and munitions of war.

He thought that one result of the export drive would be a demand for castings, such as the foundries had known for their own domestic trade. For instance, South America would be only too glad, he understood, to receive some of the hollow-ware and similar castings that could be produced in this country, without any new plant and without any new equipment. Mr. Wood hoped that that time might soon come, so that the whole industry might be doing its utmost towards the prosecution of the war.

Again thanking Mr. Dean for his understanding and appreciation of the work of the Institute, Mr. Wood said he could assure him with the fullest confidence that the whole technical resources of that Institute, and the services of every member, were entirely at the disposal of the Government towards the prosecution of the war to a successful conclusion. In that service he was confident that there was no Branch, and no Section, which would more readily co-operate and was more anxious to help than the Lancashire Branch.

Representative Guests

The toast of "Our Visitors and Guests" was proposed by the BRANCH-PRESIDENT (Mr. A. L. Key), who regretted that a variety of causes had combined somewhat to reduce the number of guests, illness, climatic conditions and the black-out all playing a part. With the exception of the Manchester Association of Engineers, so ably represented by Mr. Dean, all the kindred societies were unrepresented by reason of one or other of those causes. The company's sympathy went out to the members and guests who had been prevented from attending.

Nevertheless, there was a representative list of guests, including Mr. Dean, who held a very high position in the engineering world; Mr. Wood, representing the foundry side, and, on the technical side, providing the wherewithal for the foundryman to make his castings; Mr. R. F. Guy, representing the sphere of steam raising and combustion, and Mr. Makemson, in whom all phases were represented.

Concluding, Mr. Key expressed the great regret all felt at the absence of Mr. Lake (President of the Institute), who would have liked to be present. He had been with them on previous occasions, and they knew that he enjoyed his visits.

MR. T. MAKEMSON (Secretary of the Institute) said that, though they might be surprised to see him as a guest, he was indeed a guest by the best of all standards—the Gold Standard—because he had not paid for his ticket. (Laughter.) He thanked Mr. Wood for the very kind things he had said about him, which one knew were said with complete sincerity, and one appreciated them.

The Institute in Wartime

At the beginning of last September almost every organisation in the country wondered what its next action should be. The Institute, fortunately, did not get into a panic. What they decided to do was just to carry on. That, he thought, had been a correct and wise decision. After all, if a technical institute was of value in normal times, then surely it was of even more value in the abnormal times that they knew now. To-day members were meeting new problems; they were having different kinds of work to do, and there was an atmosphere of uncertainty. In these conditions, the individual needed a certain technical inspiration, the friendship of those in the same industry, and the guidance which could be obtained from them. Therefore, the Institute had not worried much about what it was going to do; it had carried on. Certainly, alterations had had to be made, difficulties had been encountered, and probably further difficulties would be met. But what were difficulties but things to be pushed down out of the way?

The Lancashire Branch was having, perhaps, one of its most successful sessions, in spite of the critical time, and he would like to congratulate the Branch-President upon having had such a successful year, especially at a time when some might have thought that he would have a year which would be almost a failure. Fortunately, that had not come to pass.

Finally, on behalf of the guests, and especially the ladies, he thanked the President for the way in which he had proposed their health, for the courteous welcome they had received and the kind words which had been said about them, and for the hospitality.

The R. A. Jones Medal

The next item on the programme should have been the presentation of the R. A. Jones Medal to Mr. A. Phillips (of Manchester), but MR. KEY explained with regret that the recipient and donor were both absent, the donor unfortunately having broken his ankle, and Mr. Phillips was suffering from severe tonsilitis. The medal was an award of merit for the member considered by the Council to have made the best contributions to the discussions on lectures throughout the session. The object of the award was to encourage those members who, although they might be brimful of knowledge on a particular subject, were so shy and reserved that they were inarticulate. The result had been that in the last session the discussions had become more practical and helpful in character than he had known since he became a member of the Institute in Mr. Wood's district, in Birmingham, in 1907. Members who previously never took part were now expressing themselves, asking questions, and giving explanations of various difficulties.

In the enforced absence of Mr. Phillips, the President asked Mrs. Phillips, on his behalf, to accept the medal. There was not the slightest doubt that Mr. Philips was eminently entitled to the medal. He possessed an extremely wide knowledge of the industry, and was always ready to impart it. The man who knew was alive to the fact that if he gave, he would also, in turn, receive.

Mr. Key then presented the medal to Mrs. Phillips, who suitably responded.

Following this ceremony, the company devoted the remainder of the evening to dancing.

The Balanced-Blast Cupola and Fluidity

By WM. Y. BUCHANAN

(*Continued from page* 114.)

Accuracy of Fluidity—Effect of Ramming

Ramming or mould hardness would be expected to affect the conductivity of the mould, and this in turn would affect the fluidity measurement. In order to confirm or refute this, experiments were made of which the following are typical. Several moulds were made from a carefully mixed batch of sand using varying lengths of time in jolting the drag. The results are shown in Table III.

TABLE III.—*Influence of Jolting Time on Fluidity Test Results.*

Time of jolting. Secs.	Moisture. Per cent.	Mould hardness. Penetration. Mm.	Mould hardness. Dietert.	Fluidity. Ins.	Casting temp. Deg. C.
8	7.0	27	59½	23	1,270
22	6.94	28½	58¼	21	1,270
36	6.96	24	65	21	1,270

Composition: T.C, 3.14; Si, 2.06; Mn, 1.11; S, 0.106, and P, 0.43 per cent.

The moisture was maintained constant in all tests and although the hardness measurements on each mould did not indicate a great degree of uniformity, it may be taken that by tripling the normal jolting time, the fluidity is affected to the extent of 2 in. in 23 in., but excessive jolting over this time does not produce much effect. In normal working, the machine operator was observed to judge the jolting time very accurately, and thus any variation from this cause can be ruled out.

Effect of Moisture

Moisture may also be expected to influence thermal conductivity and hence the fluidity test, but the experiments set out in Table IV tend to show that variation of moisture is accompanied by variation of hardness in moulds made by jolting, and that their effect is additive, *i.e.*,

TABLE IV.—*Effect of Moisture on Fluidity Test Results.*

Moisture. Per cent.	Mould hardness. Penetration. Mm.	Mould hardness. Dietert.	Fluidity. Ins.	Casting temp. Deg. C.
6.8	26½	61	23½	1,265
8.0	26	67	20	1,265
7.64	26¼	60	20¾	1,265
8.0	24½	67	18	1,260

Composition: T.C, 3.25; Si, 1.70; Mn, 1.14; S, 0.114, and P, 0.43 per cent.

high moisture and increased mould hardness both reduced the fluidity test length. However, in normal moulding practice, the moisture variation alone was found to have no important effect on the test, even in the case of an increase of 7 to 8 per cent. As an added precaution, however, the moisture control should be as effective as possible.

Casting from 5-cwt. tea-pot ladles, the temperature and fluidity decreases are detailed in Table V. The method of studying fluidity in cast iron for this Paper has been for the most part to take metal direct from the cupola as a basis to work upon and make the addition to this. In order to overcome the inherent variations in composition, large numbers of tests were made and only selected cases taken. That is, the predetermined analysis was taken and only those examples which conformed to this analysis were used for comparison of one particular variable. For that reason, the statements regarding fluidity are only strictly true for the particular composition used. However, this composition should be fairly representative.

Graphite Additions

When the process of melting borings was first put forward for discussion, and it was shown that it was capable of producing low-carbon cast iron, while the elements silicon, sulphur and manganese as well as phosphorus could be varied within any desired limits, the question was raised as to how the total carbon could be increased, as low carbon might be undesirable in some branches of the industry. The addition of graphite was mentioned, and a source of supply of coarse flake graphite was found readily. Extended tests were carried out by making direct additions to the runner and allowing this to wash down with the metal.

It does not seem worth while to rig up any form of constant flow hopper, but an addition of 2½ lbs. to every 10 cwts. of metal, *i.e.*, about 0.2 per cent. by weight, was found to give a rise in the percentage of total carbon of 0.1 per cent. when tested by analysis on forty consecutive days. A certain amount would be expected to be burnt, so that this percentage seems very good.

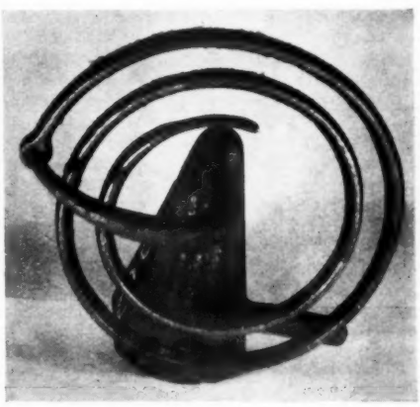

FIG. 4.—LIFE TEST FROM METAL MELTED IN A BALANCED-BLAST CUPOLA, GIVING A TEST LENGTH OF 45½ IN.

Much practical experimenting could usefully be carried out as to its effect on structure, which on preliminary tests does not seem very marked, although the additional dissolved graphite seems to be of small size, about two-thousandths of an inch in length.

Before dealing with the influence of various factors on the fluidity of cast iron, it may be of interest to record that a test taken from a 45-in. balanced-blast cupola gave a test length of 45½ in. The test-piece is illustrated in Fig. 4.

Effect of Graphite on Fluidity

Total Carbon versus Fluidity, untreated.—The effect of an increase in the total carbon percentage on an iron containing Si, 2.0; Mn, 1.0; S, 0.095, and P, 0.40 per cent., cast at 1,250 deg. C., is shown in Fig. 5. This indicates that beyond 3 per cent. total carbon, 0.2 per cent. increase produces a 6½-in. increase in the fluidity test.

Total Carbon versus Fluidity (with graphite additions).—In this case, as shown by Fig. 6, the carbon increase has a more pronounced effect on the fluidity, and 0.2 per cent. increase produces a 13-in. increase in the fluidity test. This indicates that graphite addition improves the fluidity out of all proportion to the actual amount absorbed.

Fluidity Related to Temperature

Untreated.—The increase in temperature in samples of metal containing T.C., 3.10; Si, 2.00; Mn, 0.90; S, 0.095, and P, 0.40 per cent., produces a very important effect on fluidity, five degrees Centigrade being equivalent to 1 in. in length of the fluidity spiral. This is shown in Fig. 7.

Treated with Graphite.—The effect of temperature on metal treated with graphite seems to be very similar, although the total carbon is higher by the amount of graphite addition, namely 5 deg. C. is equivalent to 0.7 in. of fluidity. Fig. 8 illustrates this.

Influence of Silicon on Fluidity

The increase in silicon was found to reduce fluidity in iron of the composition T.C, 3.15; Mn, 1.0; S, 0.09, and P, 0.40 per cent., cast at 1,250 deg. C. in the range of silicon 2.0 to 2.4 per cent. and 0.2 per cent. silicon was found to be equivalent to a 5-in. drop in fluidity test. This effect is shown in Fig. 9.

With CaSi Additions.—For increasing the silicon by ladle addition, powdered calcium silicide was used, the quantity of metal being about 50 lbs. As shown in the typical examples in Table VI, which represents additions of CaSi to small ladles of metal taken from the same teapot ladle, the fluidity falls off with increase

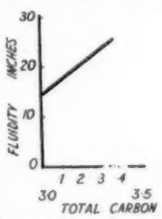

FIG. 5. — FLUIDITY *versus* TOTAL CARBON, UNTREATED.

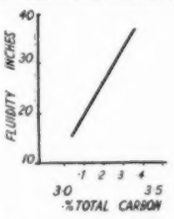

FIG. 6. — FLUIDITY *versus* TOTAL CARBON, WITH GRAPHITE ADDITION.

in silicon, and 0.2 per cent. silicon is equivalent to 6 in. decrease in fluidity.

Influence of Sulphur on Fluidity

Untreated.—The small variation in sulphur normally allowed in cast iron does not appear to have much influence on fluidity, and it does not seem worth while trying to establish a relationship for small differences in sulphur percentage.

Treated.—In order to get a decisive increase in sulphur content, powdered ferrous sulphide was added to the ladle. This appears to give an exothermic reaction, as additions produced a rise in temperature in proportion to the amount added. The fluidity is shown in Table VII to decrease as the sulphur rises, 0.02 per cent. sulphur producing a decrease of 5 to 9 in. in 30-in. fluidity length.

Influence of Phosphorus on Fluidity

Where phosphorus is intentionally used for fluidity, the higher ranges are generally used, and these enter a different group of irons altogether. However, in order to observe the effect of small additions to raise the percentage above the normal 0.40 per cent., additions were made of powdered ferro-phosphorus of about 18 to 20 per cent. P content. In normal additions, this made no difficulty due to its cooling effect, and as shown in the example in Table VIII, an increase to 0.5 to 0.6 per cent. improved the fluidity, but above this the fluidity fell away again. The reason for this is uncertain, but small additions are evidently beneficial. One per cent. may be the maximum addition which is readily absorbed in a small shank. As is well known, there is a very definite limit to the amount of cold material, which can be made in the form of ladle additions if good results are to be obtained.

Influence of Lead on Fluidity

Lead is often referred to by foundrymen of long experience as conferring greater fluidity on cast iron, and they quote examples to prove its ameliorating effects. A trial addition to the ladle appears to substantiate this claim, and it was thought worth while investigating the matter, as it is not unreasonable to suppose that the fluid lead would confer some of its characteristics on cast iron.

It should be clearly understood at the outset that lead gives off a dense white fume, which is in time very injurious to health, and this characteristic would require immediate attention if it is to be used at all. The fact that lead is said to be used in steel in order to confer free-cutting properties makes it at least interesting, and its application to cast iron should be easier, although it is said to be incorporated in steel by a special process.

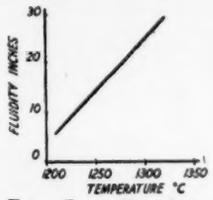

FIG. 7. — FLUIDITY *versus* TEMPERATURE, UNTREATED.

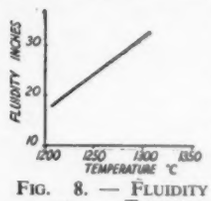

FIG. 8. — FLUIDITY *versus* TEMPERATURE, WITH GRAPHITE ADDITION.

In making additions to a ladle, the lead sunk to the bottom in the liquid state and remained volatilising slowly, the fume escaping through the metal surface, and even after all the cast iron had been poured small pools of lead were found on the bottom of the ladle. In all cases the lead-treated cast iron gave exactly the same fluidity test as the ordinary cast iron, and an addition of 0.015 per cent. to the ladle did not produce more than 0.0006 per cent. by analysis, *i.e.*, 96 per cent. loss. It is possible that the boil produced by the volatilising lead has a degasifying effect, but this was not measured.

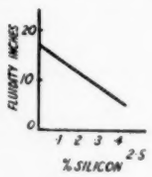

FIG. 9. — FLUIDITY *versus* SILICON, UNTREATED.

In ordinary practice one is apt to judge the degree of fluidity by the rate of movement of the oxide films under the influence of surface tension, and this is a reliable guide in plain cast iron, although it appears to be modified to some extent by the nature and quantity of the dissolved gases. Any metal or other material which has a fluxing action tends to eliminate these moving films and give a false impression of fluidity.

Influence of Copper on Fluidity

Copper was also added to cast iron in order to test its effect on fluidity. The net result was a slight decrease in fluidity due mainly to the cooling effect of the addition, and although it is evident that copper cast iron is more fluid than copper-free cast iron, it is not likely that the expense of the addition is justified for this purpose alone.

Conclusions

(1) The balanced-blast cupola gives higher fluidity than the ordinary type.

(2) The Saeger and Krynitsky fluidity test which is on the market is very useful in foundry work and in research when reasonable precautions are taken in its use.

(3) The test can be of considerable service in maintaining good fluidity as an indirect but definite precaution against the common gas-hole defect in castings.

(4) Fluidity can be improved by ladle additions, and although this field has not been entirely covered it seems that graphite is the best of the group tested and that it is suited even for machine tools where the graphite percentage should be kept low.

(5) Silicon has an adverse effect on fluidity contrary to the general opinion of foundrymen.

(6) The effect of sulphur in the presence of normal manganese is not so serious as is generally supposed, and it might usefully be employed as an addition to cast iron where chromium is used.

(7) The subject of ladle additions of special elements and their effect in this form, as distinct from cupola or furnace additions, is well worth systematic study as regards resultant structure and mechanical properties.

TABLE V.—*Influence of the Time Factor on Temperature and Fluidity Decreases.*
(Metal from 45-in. balanced-blast cupola in 4-cwt. teapot ladles.)

	Temp. Deg. C.	Fluidity. Ins.	T.C.	Si.	Mn.	S.	P.
First box cast	1,240	20½	3.26	2.50	0.79	0.096	0.49
Last box cast	1,190	17¼					
First box cast	1,240	14½	3.29	2.49	0.81	0.096	0.45
Last box cast	1,190	11½					

TABLE VI.—*Influence of CaSi Ladle Additions on Fluidity.*

Calcium silicide added.	Analysis. Per cent. T.C.	Si.	Mn.	S.	P.	Fluidity. Ins.	Temp. Deg. C.
Nil	3.17	2.22	0.745	0.092	0.46	25	1,190
2 ozs. ..	3.17	2.42	0.745	0.092	0.46	19¼	1,190
4 „ ..	3.17	2.38	0.745	0.092	0.46	18½	1,200
6 „ ..	3.17	2.45	0.745	0.092	0.46	18	1,220

TABLE VII.—*Influence of Ferrous Sulphide Additions.*

Iron sulphide added.	Analysis. Per cent. T.C.	Si.	Mn.	S.	P.	Fluidity. Ins.	Corrected fluidity. Ins.	Temp. Deg. C.
Nil ..	3.14	2.50	0.73	0.098	0.51	30	30	1,180
1 oz. ..	3.14	2.50	0.73	0.124	0.51	29	25	1,200
1¾ ozs. ..	3.14	2.50	0.73	0.121	0.51	27¾	21	1,230

TABLE VIII.—*Influence of Ferro-Phosphorus Ladle Additions on Fluidity.*

Iron phosphorus added.	Analysis. Per cent. T.C.	Si.	Mn.	S.	P.	Fluidity. Ins.	Temp. Deg. C.	Corrected fluidity. Ins.
8 ozs. ..	3.20	2.33	0.705	0.095	0.58	42	1,340	42
16 „ ..	3.21	2.32	0.715	0.093	0.66	42¾	1,340	42¾
24 „ ..	3.27	2.28	0.735	0.092	0.755	32¼	1,350	28¾
Nil ..	3.31	2.32	0.715	0.098	0.50	37	1,370	28

DISCUSSION

During the discussion which followed the Paper, MR. JAMES DONALDSON (President of the Falkirk Section of the Institute of British Foundrymen) mentioned that the first balanced-blast cupola was tried out at Carron Company's works, and said that this fact was not generally known. Paying tribute to Mr. Buchanan's work, Mr. Donaldson said it must have taken months of hard work to complete the experiments, the original nature of which had a great deal to commend them. However, the Paper was one which really required to be read before it could be fully appreciated.

After commenting upon the character of the Paper, MR. R. R. SHAW asked the lecturer how he avoided oxidation in adding the turnings and borings to the cupola. Was the graphite referred to ever in solution?

MR. BUCHANAN, in reply, said he preferred not to go into that question too deeply, but he revealed that many of his first nine trials in the melting of borings went wrong. With regard to the second question, the oxidation was taken care of by adjustment of the blast. Oxygen as such did not exist in cast iron, and oxidation therefore was either the effect of moist air or steam.

MR. T. TYRIE expressed great interest in the effect of the small additions of graphite on fluidity. Another point he was pleased to note was the statement that sulphur was not the bogey in cast iron it had been considered for so long, and that phosphorus did not produce an increasing fluidity in cast iron as so many foundrymen believed it did. It would appear that there was a maximum amount of phosphorus beyond which further additions had no relative effect in increasing fluidity. Mr. Buchanan's remarks regarding the influence of silicon on running power, too, were most interesting. Although he (the speaker) had never had the opportunity of testing the matter personally, it recalled to his mind a conversation he had with a blast-furnace manager when the latter told him that high-silicon irons did not possess the fluidity of more ordinary ones.

MR. BUCHANAN, in reply, mentioned that the fluidity test had been exploited by the Institute's Sub-Committees a few years ago, but the matter was shelved because of lack of agreement—an insufficient reason for permanent abandonment. The test could give useful information, and he would like to see other workers carrying out their own tests.

MR. NORMAN ERSKINE (President of the Scottish Branch), after adding his congratulations, referred to the balanced-blast cupola, and stated that, like others, he had always been rather puzzled by the question of volume.

MR. BUCHANAN said that for a number of years he had tried control based on volume, but the figures were more misleading than useful. For economy in operation, foundrymen must maintain the same weight throughout, and this in turn kept the rate of combustion constant; in these circumstances there should not be any marked variation. Mr. Buchanan then quoted several figures relating to temperature and the height of the bed, which was quite normal.

(*Continued on page* 141.)

Modern Electric Heat-Treatment Furnaces

By F. W. HAYWOOD, B.Sc., Ph.D., A.I.C.

(*Continued from page* 124.)

Forced-Air Circulation

A very important class of batch-type furnaces is that using forced-air circulation. These furnaces are employed for such purposes as tempering of hardened-steel components, and the secondary hardening of high-speed steel tools, etc. As a general rule, these furnaces do not work at temperatures in excess of 700 deg. C. It is well known that heat transference at low temperatures is mainly dependent upon the circulation of air or controlled atmosphere in the form of convection currents and that radiation has little effect at temperatures below 500 deg. C. Forced-air circulation provides an air circulation many times as fast as that by natural convection owing to the fact that a continual supply of air, heated to the correct temperature, is constantly passing round and through the charge. The modern type of forced-air circulation furnace comprises a heat-insulated chamber of cylindrical form with an inner concentric cylinder of metal arranged to accommodate a work basket. The heating elements are mounted in the annular space between the insulated wall and the container, the latter serving to prevent direct radiation of heat on to the charge and to confine the circulating air to a definite path. The centrifugal fan at the bottom of the chamber creates a powerful circulation of air upwards over the heating elements which is then delivered to the material in the work basket, during its descending travel. It is important to remember that the circulation is continuous, no fresh air being drawn in and no hot air being expelled from the chamber. The whole of the heat generated by the elements is thus conserved and imparted to the charge.

Any note dealing with forced-air lubrication would not be complete without reference to the latest developments in controlling equipment. In order to obtain the highest output and efficiency, the charge must be removed immediately it has reached the temperature, provided that for metallurgical reasons no soaking at temperature is required. The chilling effect of cold work on the air heated to, and controlled at, the desired temperature is utilised to enable the determination of the time when the charge is heated through to be made accurately. The thermocouple which controls the temperature must be placed in the air stream, where the air leaves the heating elements. A second thermocouple placed between the work and the fan measures the temperature of the air leaving the work and, as long as the charge is still absorbing heat in the process of heating up, the reading obtained from the lower thermocouple will be lower than that of the top. The charge progress recorder utilises this feature to provide the most simple means of ensuring high output and perfect production. The top thermocouple, in addition to controlling the temperature of the air, also records this temperature on a chart. The bottom couple records only on the same chart and in an empty furnace the two records are superimposed. When the furnace is charged, both records show a drop in temperature; that of the top couple quickly recovers, and when the set temperature is reached again the controller maintains this temperature.

The record from the bottom couple lags behind the other on account of the chilling effect mentioned above, but as soon as the two records are coincident again, it is known with certainty that no part of the charge is absorbing heat, or that the charge has reached the desired temperature. Unless the operation is of such a nature that prolonged soaking is required, the charge should be withdrawn immediately the two records are coincident, and a further charge introduced.

Whilst these notes have dealt mainly with vertical forced-air circulation furnaces, horizontal furnaces are similarly designed to develop such circulation and its contingent benefits to the fullest extent. It should also be borne in mind that centrifugal fans are in some cases fitted in the roof of batch furnaces of the standard box type, where the temperature is not in excess of 700 to 750 deg. C. The use of fans to obtain uniformity of temperature frequently offers a method far less costly than that of dividing the furnace into a number of zones, each being automatically controlled separately.

Types of Furnaces

It is as well to mention a representative number of types of furnaces used in industry which employ forced-air or atmospheric circulation. There are vertical furnaces used for piston pot production, tool-steel tempering, and the secondary hardening of high-speed steels. A second type embraces nitriding furnaces, in which the circulation of anhydrous ammonia over special steels and cast irons during processing is maintained, and bright tempering furnaces where, instead of circulating air, a controlled atmosphere is employed.

The production of continuous furnaces electrically heated followed after the development of the batch-type furnace, and it is natural, therefore, that the heating chamber or zone of continuous furnaces should follow very closely the construction of batch-type furnaces. All the forms of construction given previously in this Paper are used, namely, wound chambers, grooved or ungrooved, for low-temperature furnaces; heavy hairpin and tubular-hairpin elements for higher temperature furnaces, sinuous elements in the form of wire, strip and rod, and recrystallised silicon-carbide rods, for very high-temperature work.

Generally speaking, the design of any particular continuous furnace will depend upon the specific heat-treatment required and the material being treated. Also, the method of conveying the work through the furnace is very largely dependent upon the nature of the work and the particular heat-treatment which the work has to undergo. Thus the following list gives a few typical cases:—

(1) Straight-through continuous furnaces using mesh-belt, band, chain-link, pans, etc., as conveyors for heat-treatment such as bright-annealing, normalising, stress-relieving, etc.

(2) Straight-through continuous furnaces using roller hearths, special pusher gear and charging and discharging mechanism, walking beams, pusher types, etc.

(3) Strand annealing furnaces for wire patenting and strip furnaces for annealing, normalising or hardening.

(4) Vertical continuous furnaces for annealing, etc.

(5) Continuous furnaces used for hardening where an exit cooled section is not required, but is replaced by a quenching tank, the material being conveyed through the furnace by any of the means previously stated.

(6) Rotary drum furnaces for annealing and hardening small parts.

Controlled Atmospheres

In practically every heat-treatment process, the heated material is in contact with a gaseous atmosphere with which it may react. Unless a controlled atmosphere is used, this atmosphere will contain free oxygen which will produce oxidation and scaling of the material. The natural atmosphere in electrically heated furnaces in which a controlled atmosphere is not introduced contains, besides air, traces of water vapour, particularly if the furnace is not muffled. By the use of a controlled atmosphere in heat-treatment furnaces, oxygen and water vapour can be eliminated, tarnishing and scaling avoided, the resulting metal or alloy being either perfectly bright or clean depending upon the atmosphere used and certain other factors. Thus abrasive cleaning methods or pickling are obviated.

For the sake of convenience the atmospheres generally employed in this country for bright heat-treatment processes may be conveniently divided into two categories—carbonaceous and non-carbonaceous.

Carbonaceous Gases

Gases such as blast-furnace gas, producer gas, water gas, coke-oven gas, etc., are available and these may be used after suitable purification, to provide a controlled atmosphere for certain bright-thermal treatments. Charcoal may be used for the production of a protective atmosphere suitable for many ferrous heat-treatment processes. Under normal working conditions this gas contains 25 to 30 per cent. carbon monoxide, 1 to 3 per cent. of carbon dioxide, 1 to 3 per cent. of hydrogen and traces of hydrocarbons. A well-designed modern charcoal burner is capable of giving very clean hardening at normal working temperatures with entire absence of decarburisation of high carbon steels.

Most ferrous materials are bright heat-treated in atmospheres derived from liquid or gaseous carbon compounds. In recent years coal gas has very largely superseded bottled hydrocarbon gases owing largely to the fact that the atmosphere derived from burnt coal gas is cheaper than, say, burnt butane. Furthermore, coal gas is available "on tap" in practically every heat-treatment shop. Not infrequently raw-coal gas is used for certain processes and quite often it is burnt with a controlled amount of air giving a gas mixture consisting of carbon monoxide, carbon dioxide, hydrogen and nitrogen.

Whilst atmospheres derived from carbonaceous materials possess a number of undesirable characteristics, such as shifting equilibria, explosive nature, toxicity, contain water vapour unless dried, contain traces of sulphur compounds, they are, nevertheless, produced easily and are extremely cheap to use.

Non-Carbonaceous Atmospheres

The choice of atmospheres is now limited to practically two, namely, nitrogen and hydrogen, which may be used either separately or as a mixture. Owing to the cost of these gases when bottled, their use is very limited but a particularly convenient raw material capable of producing mixtures of nitrogen and hydrogen is available in the form of anhydrous ammonia which is an extremely pure raw material. The atmospheres which can be produced from anhydrous ammonia are as follow:—

Cracked Ammonia.—This consists essentially of a mixture containing 75 per cent. hydrogen and 25 per cent. nitrogen with not more than 0.10 per cent. by volume of free ammonia. It is entirely free from all traces of oxygen and water vapour, it is explosive in character but when applied to furnaces specifically designed for the use of protective atmospheres, no difficulties are encountered.

Burnt Ammonia.—By the controlled combustion of cracked ammonia with air, a gas

which consists essentially of nitrogen admixed with hydrogen is obtained. In commercial plants it is usual to control the combustion so that the resulting gas mixture varies between the limits—nitrogen 90 to 99 per cent., and hydrogen 10 to 1 per cent. It is generally admitted that the ideal atmosphere for most bright heat-treatments is nitrogen admixed with a small percentage of hydrogen, it being preferable to have such a mixture entirely free from water vapour and free oxygen. Such an atmosphere is produced by the ammonia burner and this may be used for the bright thermal treatment of practically every metal and alloy. The gas possesses the properties of being non-toxic, non-inflammable and non-explosive, with entire absence of oxygen and entire absence of water vapour if desired, freedom from sulphur and carbon compounds, extreme purity and constancy of analysis, and does not react at temperature with alloys undergoing heat-treatment. Unfortunately there is one factor which militates against its general use, namely, its much higher cost than that of protective atmospheres derived from carbonaceous gases, this figure being 7s. 6d. to 10s. per 1,000 cub. ft. of gas, compared with a general figure of from 2s. to sixpence for 1,000 cub. ft. of burnt butane and burnt town gas respectively.

Research work carried out by Imperial Chemical Industries, Limited, resulted, however, in their patented Regenerative Ammonia Burner in which the principles of regeneration are used. By this means the atmosphere is used over and over again and it has been found possible to reduce the cost generally to the order of ninepence to one shilling per 1,000 cub. ft. of recirculated atmosphere, and in special cases down to a figure of 6d. to 8d. per 1,000 cub. ft. It will be appreciated that if a perfectly dry atmosphere of burnt ammonia is required, it will be necessary to dry the gas after combustion. This has been accomplished with entire satisfaction in regenerative-type driers using a drying medium such as silica gel or activated alumina.

Almost any modern type of electric furnace can be designed for use with controlled atmospheres, the best results being obtained when a furnace has been designed specifically for use with a particular material and atmosphere. Some of the first electric furnaces in this country to use protective atmospheres were batch furnaces of the bell-base or top-hat type, where a series of sealed containers were used in conjunction with a single furnace or where multiples of such a system were used. Other batch-type furnaces using retorts or pots with special seals employ a very similar procedure except that the furnace itself is often fixed, and the retorts or pots are placed into the furnace and withdrawn for cooling. Batch furnaces proper, that is, furnaces of the box type which do not use a metal container, but possess a door or doors opening straight to atmosphere, should definitely not be used for perfect bright thermal treatments—they find extensive applications, as previously mentioned, for box carburising, reheating, hardening, etc. Whilst it is much more difficult to apply controlled atmospheres to such furnaces, they are almost invariably fitted with the necessary equipment to produce atmospheres derived usually from carbonaceous gases.

One of the latest developments in connection with batch furnaces is the MacDonald recuperative bright-annealing system. This new system involves a forced circulation of protective atmosphere inside the bells, so that the medium of heat transfer, namely, protective atmosphere, has actual contact with the charge itself. Whilst the system is not limited to batch furnaces, it is particularly advantageous when applied to bell-base furnaces, as, owing to the heat recuperation being as high as 35 per cent. and the consumption of protective atmosphere being low, it offers a highly efficient system of bright annealing.

Continuous Furnaces

Continuous furnaces of all types are extensively used for the bright thermal treatment of ferrous materials, and whilst not being absolutely essential in some cases, it is preferable to employ a muffle through the heating zone or chamber. This prevents any attack which might take place between the resistor elements and the gas atmosphere, and also prevents the atmosphere being contaminated by oxygen, water vapour and extraneous gases which may be picked up by the refractories. An important point in connection with continuous furnaces using controlled atmospheres is the disposition of the gas-inlet points. Generally, while a number of inlet points may be provided in and near to the heating chamber proper, the main supply is usually into the heated chamber at the exit cooler end. A point which is sometimes overlooked, and one likely to cause considerable trouble, is that a continuous furnace, whilst being disposed in relation to the general layout of the heat-treatment shop to occupy its normal position in the production line, is seldom shielded from external drafts. Although sealing devices of various types, comprising curtains, flaps, doors, etc., are nearly always used at each end of a furnace, very slight drafts may affect the flow of protective atmosphere in the furnaces.

One of the latest types of continuous furnace is constructed so that the inlet duct, heating zone and cooling duct are on the arc of a circle with the two ends of the furnace being at exactly the same level. If an atmosphere, lighter than air, is used in such a furnace, the effect of turning down the ends is two-fold. Firstly, the furnace is self-sealing, and, secondly, there is a very marked saving in atmosphere effected by such construction over the more conventional horizontal type.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

514,253. MEEHANITE METAL CORPORATION, and SMALLEY, O. Process of and apparatus for the manufacture of cast iron.

514,292. NASH, R. J., MYERS, R. M., and WEIPPERT, E. D. Manufacture of hollow cast metal articles.

514,311. TAIT, W. H. Electromagnetic apparatus for testing the thickness of coatings upon basis material.

514,346. STEIN & ATKINSON, LIMITED (Stein & Roubaix Soc. Anon.). Conveyor apparatus for furnaces.

514,432. BRITISH DRIVER-HARRIS COMPANY, LIMITED, and KAY, W. M. Corrosion-resistant alloys.

514,443. PYRENE COMPANY, LIMITED, and CLIFFORD, W. J. (Parker Rust Proof Company [in part]). Improving the resistance of metals to corrosion.

514,472. UDY, M. J. Making chromium iron or steel alloys, and compositions for use in said process.

514,474. SPLADIS SOC. POUR L'APPLICATION D'INVENTIONS SCIENTIFIQUES. Centrifuging electrically-heated furnace.

514,491. RENNERFELT, I., and KALLING, B. M. S. Decarbonisation of carbon-containing metals and ferro-alloys.

514,527. KINKEAD, R. E. Surface alloying of metal bodies.

514,593. SERI HOLDING SOC. ANON. Improving iron-beryllium alloys.

515,250. SOC. D'ELECTROCHIMIE, D'ELECTROMETALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Apparatus for effecting metallurgical reactions regularly and rapidly.

515,253. MEHTA, F. P. Method of refining pig-iron for conversion into steel.

Cast-Iron Core Grids

BY "FOUNDRYMAN."

Although the advent of oil sand revolutionised the art of core-making and reduced considerably the amount of support required to be given to a core, the use of cast-iron grids has not been eliminated entirely. Grids are necessary in cores for support during casting and also to facilitate handling and assembly in the mould. The production of grids is one of the simplest of moulding operations, as they are invariably cast "open sand." After a bed has been prepared the core-maker marks out the grids required, using rule, compass, square, etc. This takes a fair amount of time and, to economise, templates of the core boxes are frequently supplied which can be placed on the bed and marked around, the core-maker having only to stamp out the impression of the bar required and not worry about measuring.

A further stage in time-saving is reached when the core-maker is supplied with a "stamp." This is a replica of the required grid and placed on a plain piece of wood which is stamped into the sand bed. The preparation of the bed is often done in various places in the shop where a pile of sand has accumulated. This is not the best way, as often the sand gets burnt and contaminated with pellets of spilt iron, etc., and is not then so useful for moulding purposes. Also much time is taken in preparing a level bed. Both these disadvantages can be eliminated by reserving a portion of the shop for the

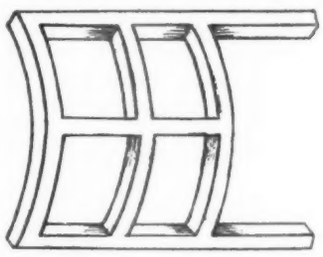

FIG. 1.—CAST-IRON GRID MADE TO CARRY LOOSE MIDDLE PART OF A MOULD.

manufacture of open-sand castings. This can be done by either keeping a large moulding box permanently levelled or else two guide rails can be fixed at shop level between which the bed can be prepared. All that is required each time is that the sand is renewed and levelled by the rails.

Often composite grids are necessary because of the difficulty involved in casting to certain shapes, although grids can be made from patterns mounted on joint boards. Fig. 1 illustrates such a case in which a grid was required to carry a loose middle portion of a mould, the joints of which were curved, and the thickness of the sand was only 3 in. It may be thought that this could be carried by a number of wrought-iron bars, but in this particular case they would lack the necessary rigidity as supplied by a cast-iron grid. This particular example was made in two boxes, a joint board was made and a pattern of the grid built on it loosely. The bottom being moulded, the whole was turned over, the joint board removed, the top rammed, and finished off in the ordinary way.

ACCORDING TO the late Mr. A. Stockburn, whose posthumous Paper on "The Solubility of Lead in Tin" appears as Preprint No. 861 of the Institute of Metals, the solubility of lead in tin at temperatures higher than 183 deg. C. as measured by the micrographic and the electrical resistance methods shows that the maximum solubility of lead in tin is more than 2.0 and less than 2.1 per cent. by weight. These experiments have been carried out using tin from three different sources.

Chromium-Silicon Cast Iron*

By A. L. NORBURY, D.Sc., and E. MORGAN, M.Sc.

Summary

This Paper contains a survey of the microstructures, tendency to chill, mechanical properties (such as Brinell hardness, machinability, tensile strength, transverse strength, deflection and repeated impact values) and air- and oil-hardening capacities of cast irons having chromium contents between 0 and 15 per cent. and silicon contents between 1 and 11 per cent. The results are presented in the same way as those previously published on manganese-silicon and nickel-silicon cast irons.[1] The conclusions from the results may be summarised as follow:—

(1) One per cent. of 69 per cent. ferro-chromium added to crucible melts increased the chromium content of the resulting cast, on an average, by 0.6 per cent. chromium.

(2) Increasing the chromium content stabilised the pearlite and secondary cementite and caused white iron eutectic to replace graphite, but did not cause self-hardening or the replacement of pearlite by martensite, etc.

(3) In cast irons of normal total carbon content, the chill-producing action of 1 per cent. chromium neutralised the chill-reducing action of about 1 per cent. silicon.

(4) Chromium increased the Brinell hardness and reduced the machinability. In most compositions it increased the mechanical strength and reduced the deflection.

(5) As the chromium content increased, the white iron eutectic assumed the form of carbide crystals in a ferrite matrix, instead of austenite globules in a carbide matrix.

(6) Experiments not included in this Paper showed that chromium raises the freezing point of the white iron eutectic.

Previous Investigations

Summaries of investigations on the effect of chromium on cast iron have been given by Northcott[2] and by Everest.[3] The results obtained by previous investigators have indicated that the chief useful effect of chromium on grey cast iron is that it tends to stabilise the pearlite and prevent the formation of ferrite on cooling through the pearlite transformation. Additions of chromium to cast iron, consequently, may be made to reduce growth in certain cases, to improve the resistance to abrasion and erosion in others, and to stabilise the combined carbon in castings having large cross-section. Nickel is often used in conjunction with chromium, since it offsets the latter's action of increasing the tendency to chill. Ni-Resist, an iron containing 15 per cent. nickel, 5 per cent. copper and 2 to 5 per cent. chromium, is used for corrosion-, erosion- and growth-resisting purposes. White irons containing about 13 per cent. chromium and upwards are used for heat-resisting purposes for dies on draw benches. A patent has been granted for an iron containing 8 to 20 per cent. chromium plus 1 to 3.5 per cent. carbon, which may be hardened and rendered stainless and rustless by heating to 1,150 to 1,250 deg. C. and quenching in water.

Amongst investigations on the effect of chromium on the mechanical properties of grey cast iron, that of Hamasumi[4] gave the tensile strength and Brinell hardness of seven 1.2-in. diameter sand-cast bars containing about 3.0 per cent. total carbon and 1.60 per cent. silicon and various chromium contents between 0.24 and 1.80 per cent. Hamasumi found that increasing the chromium from 0.24 to 0.90 per cent. increased the tensile strength from 21 to 26 tons per sq. in. and the Brinell hardness from 179 to 252, and that the bars were mottled with chromium contents of 0.9 per cent. and upwards.

New interest has recently been raised in the subject matter of this Paper (which was first issued in 1931) by a Paper and patents on "Loded" Cast Irons, by H. J. Young. These irons contain 2.5 to 7 per cent. silicon and would normally be ferritic, but are made pearlitic by the addition of 1 to 4 per cent. chromium.

Method of Melting

In the present investigation, 50-lb. charges were melted in a salamander crucible in a coke-fired furnace from mixtures of Swedish white iron (4.0 per cent. total carbon), 40 per cent. ferro-silicon, Armco iron, 80 per cent. ferro-manganese and 20 per cent. ferro-phosphorus. There was little loss of manganese, silicon or phosphorus on melting under these conditions; 1 per cent. ferro-manganese produced about 0.75 per cent. manganese and 0.06 per cent. carbon in the melt, and 1 per cent. ferro-silicon gave 0.40 per cent. silicon.

From each 50-lb. charge, five different sets of test-bars were usually cast, each set consisting of 1.2-in., 0.875-in., 0.6-in. and 0.4-in. diameter round bars, each 16 in. long. After casting the first set of bars from a melt, either the silicon or chromium content was increased by the addition of either ferro-silicon or ferro-chromium to the melt, which was then reheated and another set of bars cast. Further additions and further reheating was then carried out until the complete series had been made from each melt. The bars were top poured in green-sand moulds at an angle of 30 deg. to the vertical. The chromium was added in the form of 69 per cent. ferro-chrome containing 1.5 per cent.

TABLE I.—*Chemical Analyses and Mechanical Properties, Series A.*

Silicon	Per cent.	1.64	2.42	2.67	3.53	4.20
Chromium	,,	0.67	—	—	—	0.56
Total carbon	,,	3.05	2.98	2.94	2.80	2.66
Combined carbon	,,	1.35	0.81	0.75	0.73	0.48
Other elements	,,	Mn 1.00 and P 0.30				
Transverse strength. Tons per sq. in. — 1.2 in. dia.		33*	33	32	31	26
0.875 in. ,,		30*	35	36	30	27
0.6 in. ,,		36*	38*	43*	33*	42*
0.4 in. ,,		29*	33*	36*	29*	31*
Deflection. Inches on 14-in. centres — 1.2 in. dia.		—	—	—	—	—
0.875 in. ,,		—	—	—	—	—
0.6 in. ,,		—	—	—	—	—
0.4 in. ,,		—	—	—	—	—
Tensile strength	Tons per sq. in.	Un.	Un.	18.4	18.0	14.0
Brinell hardness No.		348	265	265	265	281
Repeated impact (No. of blows)		Un.	Un.	751	582	577

TABLE II.—*Chemical Analyses and Mechanical Properties, Series B.*

Silicon	Per cent.	2.73	—	2.38
Chromium	,,	0.51	0.81	1.78
Total carbon	,,	2.81	—	2.79
Combined carbon	,,	—	—	—
Other elements	,,	Mn 0.40 and P 0.30		
Transverse strength. Tons per sq. in. — 1.2 in. dia.		35	37	21*
0.875 in. ,,		11	—	21*
0.6 in. ,,		44	42	25*
0.4 in. ,,		44*	26*	—
Deflection. Inches on 14 in. — 1.2 in. dia.		0.22	0.16	0.09
0.875 in. ,,		0.05	—	0.09
0.6 in. ,,		0.28	0.23	0.12
0.4 in. ,,		0.34	0.22	—
Tensile strength	Tons per sq. in.	22.6	23.4	Un.
Brinell hardness No.		263	291	443
Repeated impact (No. of blows)		2,061	2,000	Un.

TABLE III.—*Chemical Analyses and Mechanical Properties, Series C.*

Silicon	Per cent.	5.04	—	—	—	4.90
Chromium	,,	0.56	0.87	1.16	1.06	3.48
Total carbon	,,	2.49	—	—	—	2.52
Combined carbon	,,	0.25	—	—	—	0.98
Other elements	,,	Mn 0.50 and P 0.30				
Transverse strength. Tons per sq. in. — 1.2 in. dia.		30	29	25	26	—
0.875 in. ,,		29	26	17	30	22
0.6 in. ,,		31	30	36	32	35
0.4 in. ,,		38	42*	40*	27*	—
Deflection. Inches on 14 in. — 1.2 in. dia.		0.16	0.23	0.22	0.19	—
0.875 in. ,,		0.18	0.15	0.09	0.15	0.13
0.6 in. ,,		0.21	0.19	0.24	0.22	0.25
0.4 in. ,,		0.32	0.40	0.30	0.30	—
Tensile strength	Tons per sq. in.	15.3	14.8	15.1	14.5	—
Brinell hardness No.		217	224	260	280	299
Repeated impact (No. of blows)		46	143	209	573	1,148

* Revised from Research Report No. 93 of the British Cast Iron Research Association.

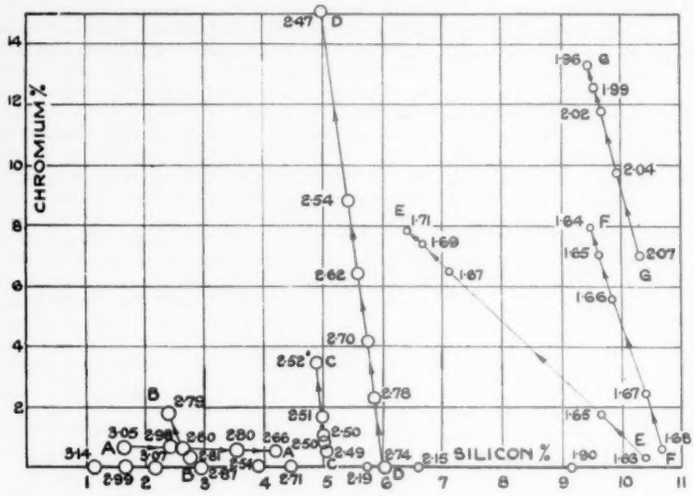

FIG. 1.—TOTAL CARBON CONTENTS.—The size of each circle indicates the total carbon content. Irons joined by arrows were cast from the same melt after additions of 69 per cent. ferro-chromium or 40 per cent. ferro-silicon.

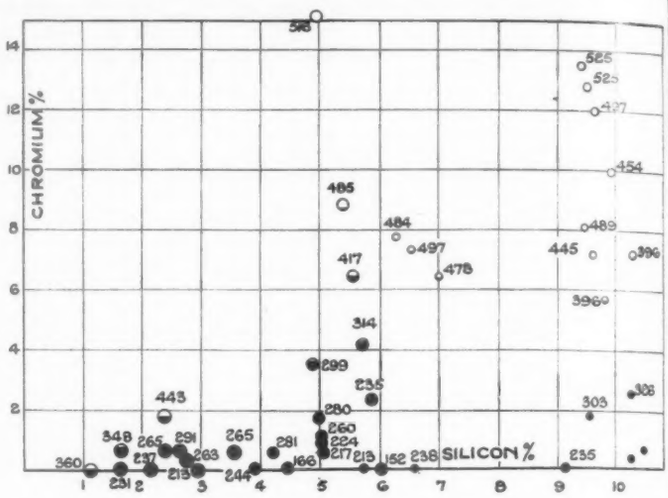

FIG. 2.—BRINELL HARDNESS NUMBERS (10/3,000/30), 1.2-IN. BARS.—The size of each circle indicates the total carbon content (see Fig. 1). The proportion of black to white in each circle indicates the proportion of grey to white iron present.

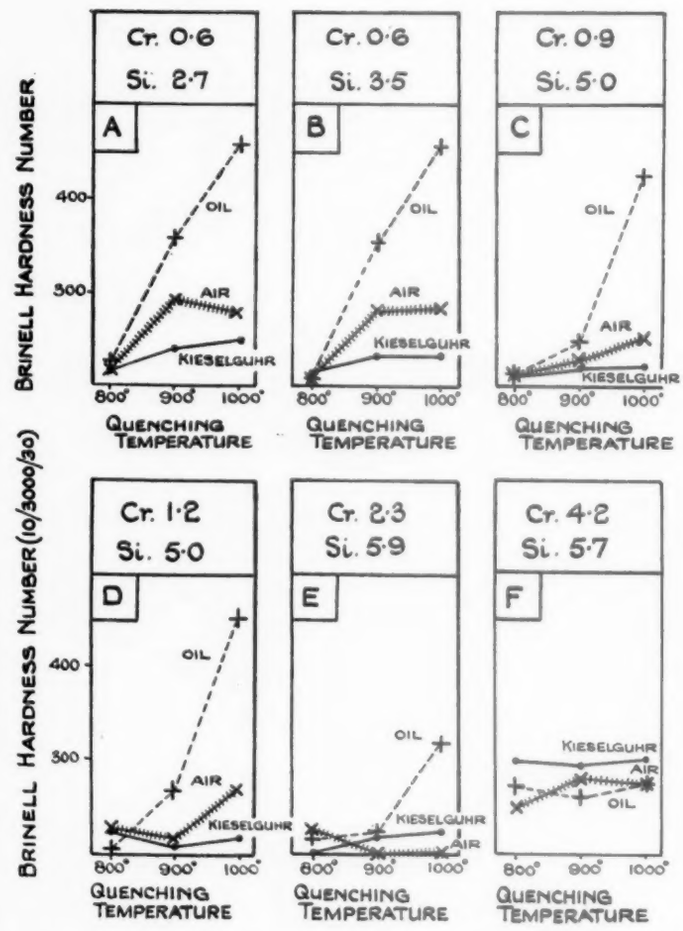

FIG. 4.—EFFECT OF HEATING TO 800, 900, AND 1,000 DEG. C., FOR ½ HR., AND COOLING IN KIESELGUHR, AIR AND OIL, ON THE BRINELL HARDNESS OF CERTAIN CHROMIUM-SILICON CAST IRONS.

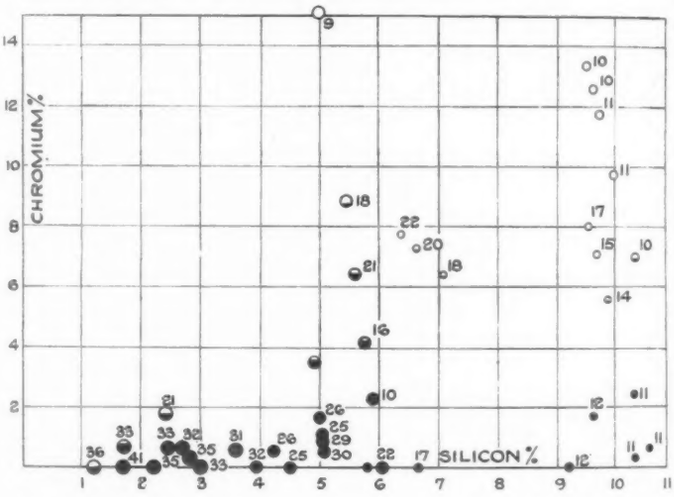

FIG. 3.—TRANSVERSE STRENGTHS (TONS PER SQ. IN.), 1.2-IN. BARS.—The size of each circle indicates the total carbon content (see Fig. 1). The proportion of black to white in each circle indicates the proportion of grey to white iron present.

FIG. 5.—CHROMIUM 0.56 PER CENT., SILICON 5.0 PER CENT. (T.C 2.49 PER CENT., MN 0.5 PER CENT., P 0.3 PER CENT.).—Increasing the chromium from 0.0 per cent. to 0.56 per cent. has made the matrix half pearlitic and half ferritic, instead of completely ferritic. Amidst the pearlite some white iron, surrounded by ferrite, is visible. The phosphide is surrounded by pearlite.

Photomicrographs are of 1.2-in. diameter sand-cast bars, etched in alcoholic picric acid and at 200 diameters magnification.

carbon. On an average, 1 per cent. of the alloy gave 0.58 per cent. chromium content in the cast.

The chromium, silicon and total carbon contents of the various irons made are plotted in Fig. 1. Compositions joined by arrows were cast from the same crucible melt with intermediate additions of ferro-chrome or ferro-silicon.

Microstructures of 1.2-in. Bars

Typical microstructures of 5 per cent. silicon irons with increasing chromium contents from 0 to 15 per cent. are shown in Figs. 5 to 9. Figs. 5 and 6 show the replacement of ferrite by pearlite, due to the stabilisation of eutectoid carbide as the chromium content is increased to 0.56 and 1.66 per cent. An iron of an otherwise similar composition, but with no chromium addition, would be completely ferritic. Chromium also stabilises the secondary cementite, which may be seen as dark patches in the pearlite in Figs. 6 and 7. The 0.56 and 1.66 per cent. chromium irons in Figs. 5 and 6 also contain a certain amount of white iron eutectic, and as the chromium content is further increased (in Figs. 7, 8 and 9), the graphite flakes are progressively replaced by white iron eutectic.

It will also be noted that as the chromium content increases, the white iron eutectic changes its form from one of pearlitic globules in a ground mass of cementite to one of carbide crystals in a ground mass of ferrite. The ferrite is produced by the action of chromium of forming δ iron in place of γ iron.

Micrographs of 10 per cent. silicon irons containing 2.4, 5.6, and 13.4 per cent. chromium, in Figs. 10, 11 and 12, again show the progressive replacement of graphite by white iron eutectic as the chromium content increases, and the change of the white iron eutectic to crystals of carbide in a ferrite matrix.

Combined Carbon Contents

The combined carbon contents of the high chromium irons could not be estimated by the ordinary methods of analysis, since some of the carbides were very difficult to dissolve and separate from the graphite. The condition of the carbon can, however, be fairly accurately deduced from microscopic examination, and the relative amounts of grey and white iron present in the various irons cast are approximately indicated in Figs. 2 and 3 by the relative amounts of black and white in the circles.

In normal total carbon irons, as a rough figure, it may be said that the chill-producing action of adding 1 per cent. chromium neutralises the chill-reducing action of about 1 per cent. silicon. In the case of the 5 per cent. silicon irons, the combined carbon was 0.25 per cent. in the 0.56 per cent. chromium iron (Fig. 5), and was 0.98 per cent. in the 3.46 per cent. chromium iron (Fig. 7). In the latter iron, considerable amounts of white iron eutectic are present (see Fig. 7). Consequently, the 0.98 per cent. combined carbon is accounted for by the areas of white iron eutectic plus areas of pearlite of relatively low carbon content, since in 5 per cent. silicon irons the eutectoid carbon content is about 0.6 per cent. with no chromium, and is probably lowered as the chromium content increases, since in the case of steels it has been found that increasing the chromium content lowers the eutectoid carbon content of 0.89 per cent. with no chromium, to 0.6 per cent. with 3 per cent. chromium, and to 0.3 per cent. with 12 per cent. chromium.

Brinell Hardness of 1.2-in. Bars

The results of Brinell hardness tests, 10 mm. ball/3,000 kg. load/30 seconds, are plotted in Fig. 2, and are given in Tables I-IX. It will be seen that increasing the chromium increases the Brinell hardness in all cases, and does this by making ferritic irons pearlitic, and by making carbide replace graphite.

TABLE IV.—*Chemical Analyses and Mechanical Properties, Series D.*

Silicon	Per cent.	5.86	—	—	—	4.96
Chromium	,,	2.33	4.16	6.46	8.85	15.10
Total carbon	,,	2.78	—	—	—	2.47
Combined carbon	,,	—	—	—	—	—
Other elements	,,	Mn 1.40 and P 0.30				
Transverse strength. Tons per sq. in.	1.2 in. dia.	10	16	21*	18*	9*
	0.875 in. ,,	11	18	22*	24*	19*
	0.6 in. ,,	33	22	24*	19*	—
	0.4 in. ,,	—	—	—	—	—
Deflection. Inches on 14 in.	1.2 in. dia.	0.08	0.07	0.08	0.07	0.02
	0.875 in. ,,	0.10	0.09	0.09	0.07	0.09
	0.6 in. ,,	0.14	0.14	0.14	0.07	—
	0.4 in. ,,	—	—	—	—	—
Tensile strength	Tons per sq. in.	—	7.8	Un.	Un.	Un.
Brinell hardness No.		235	314	417	485	516
Repeated impact (No. of blows)		1	1	Un.	Un.	Un.

TABLE V.—*Chemical Analyses and Mechanical Properties, Series E.*

Silicon	Per cent.	10.32	—	—	—	6.33
Chromium	,,	0.37	1.75	6.43	7.29	7.78
Total carbon	,,	1.63	—	—	—	1.71
Combined carbon	,,	—	—	—	—	—
Other elements	,,	Mn 1.20 and P 0.30				
Transverse strength. Tons per sq. in.	1.2 in. dia.	11	12	18	20	22
	0.875 in. ,,	13	—	16	21	23
	0.6 in. ,,	14	14	16	29*	22*
	0.4 in. ,,	30	10	17	17*	26*
Deflection. Inches on 14 in.	1.2 in. dia.	0.05	0.03	0.04	0.04	0.06
	0.875 in. ,,	0.07	—	0.04	0.08	0.05
	0.6 in. ,,	0.08	0.08	0.05	0.12*	0.09*
	0.4 in. ,,	0.14	0.11	0.05	0.15*	0.20*
Tensile strength	Tons per sq. in.	Un.	Un.	Un.	Un.	Un.
Brinell hardness No.		—	303	478	497	484
Repeated impact (No. of blows)[1]		Un.	Un.	Un.	Un.	Un.

TABLE VI.—*Chemical Analyses and Mechanical Properties, Series F.*

Silicon	Per cent.	10.59	—	—	—	9.50
Chromium	,,	0.63	2.46	5.65	7.13	7.99
Total carbon	,,	1.68	—	—	—	1.64
Combined carbon	,,	—	—	—	—	—
Other elements	,,	Mn 0.90 and P 0.05				
Transverse strength. Tons per sq. in.	1.2 in. dia.	11	11	14*	15*	17*
	0.875 in. ,,	14	14	6*	15*	18*
	0.6 in. ,,	15	15	5*	—	—
	0.4 in. ,,	19	14	—	12*	—
Deflection. Inches on 14 in.	1.2 in. dia.	0.04	0.05	0.03	0.04	0.05
	0.875 in. ,,	0.09	0.06	0.02	0.05	0.03
	0.6 in. ,,	0.12	0.09	0.02	—	—
	0.4 in. ,,	0.21	0.13	—	0.06*	—
Tensile strength	Tons per sq. in.	Un.	Un.	Un.	Un.	Un.
Brinell hardness No.		—	326	396	445	489
Repeated impact (No. of blows)		Un.	Un.	Un.	Un.	Un.

TABLE VII.—*Chemical Analyses and Mechanical Properties, Series G.*

Silicon	Per cent.	10.32	—	—	—	9.43
Chromium	,,	7.06	9.79	11.81	12.60	13.47
Total carbon	,,	2.07	—	—	—	1.96
Combined carbon	,,	—	—	—	—	—
Other elements	,,	Mn 1.00 and P 0.05				
Transverse strength. Tons per sq. in.	1.2 in. dia.	10	11	11	10	10
	0.875 in. ,,	11	12	9	14	—
	0.6 in. ,,	10	10	23	5	19
	0.4 in. ,,	17	14	13	19	14
Deflection. Inches on 14 in.	1.2 in. dia.	0.02	0.01	0.02	0.04	0.03
	0.875 in. ,,	0.04	0.02	0.04	0.03	—
	0.6 in. ,,	0.02	0.04	0.08	0.02	0.07
	0.4 in. ,,	0.12	0.12	0.11	0.12	0.12
Tensile strength	Tons per sq. in.	Un.	Un.	Un.	Un.	Un.
Brinell hardness No.		396	454	497	525	525
Repeated impact (No. of blows)		Un.	Un.	Un.	Un.	Un.

Machinability

The 1.2-in. and 0.875-in. bars of the 2 per cent. silicon irons with normal carbon contents were machinable with high-speed steel up to chromium contents of about 1 per cent. With higher chromium contents the bars were too mottled to machine. Similarly, the 5 per cent. silicon irons were machinable up to chromium contents of about 4 per cent.

Tensile Strength, 1.2-in. Bars

In the 5 per cent. silicon irons, increasing the chromium content from 0.56 to 1.66 per cent. did not appreciably affect the tensile strength (see Table III, Series C). In the 3.0 per cent. total carbon, 1.6 per cent. silicon irons, Hamasumi found that increasing the chromium from 0.24 to 0.90 per cent. progressively increased the tensile strength from 21 to 26 tons per sq. in.

Transverse Strength, 1.2-in. Bars

The figures are somewhat erratic, but suggest that chromium lowers the transverse strength when it makes 5 to 6 per cent. silicon irons pearlitic, and then increases the strength as the bars become mottled, and then decreases it again as increasing amounts of white iron are formed.

Deflection in Transverse, 1.2-in. Bars

Chromium decreases the deflection by making ferritic irons pearlitic, or by making grey irons mottled and white (see Tables I to VII).

Repeated Impact Values, 0.875-in. Bars

Chromium increases the repeated impact value by making 5 to 6 per cent. silicon ferritic irons pearlitic, and grey irons mottled. The following results were obtained on the 5 per cent. silicon series of iron (2.5 per cent. total carbon):—

Repeated impact value	46	143	209	573	1,148
Chromium, per cent.	0.56	0.87	1.16	1.66	3.46
Combined carbon, per cent. ..	0.25	—	—	—	0.98

Air-Hardening and Oil-Hardening

The results of some experiments on air-

FIG. 6.—CHROMIUM 1.66 PER CENT., SILICON 4.9 PER CENT. (T.C 2.51 PER CENT., MN 0.5 PER CENT., P 0.3 PER CENT.).

Increasing the chromium to 1.66 per cent. has made the matrix completely pearlitic. Dark patches of secondary cementite and of white iron surrounded by ferrite are also visible. The phosphide is surrounded by pearlite.

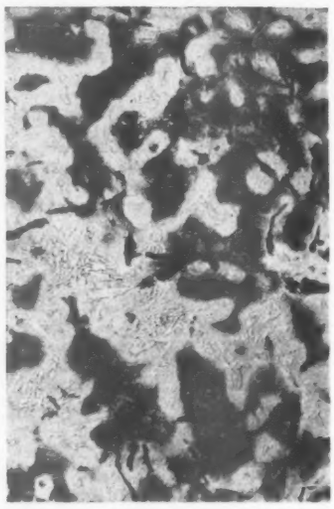

FIG. 7.—CHROMIUM 3.4 PER CENT., SILICON 4.9 PER CENT. (T.C 2.52 PER CENT., MN 0.5 PER CENT., P 0.3 PER CENT.).

Increasing the chromium to 3.4 per cent. has caused about half the graphite to be replaced by white iron which is surrounded by ferrite. The matrix of the primary dendrites and that surrounding the graphite is pearlitic.

FIG. 8.—CHROMIUM 6.4 PER CENT., SILICON 5.6 PER CENT. (T.C 2.62 PER CENT., MN 1.4 PER CENT., P 0.3 PER CENT.).

Still more graphite has been replaced by white iron. The matrix of the primary dendrites and that surrounding the graphite is pearlitic.

FIG. 9.—CHROMIUM 15.1 PER CENT., SILICON 4.9 PER CENT. (T.C 2.47 PER CENT., MN 1.4 PER CENT., P 0.3 PER CENT.).

The graphite has been almost completely replaced by white iron. The alloy is near the eutectic composition.

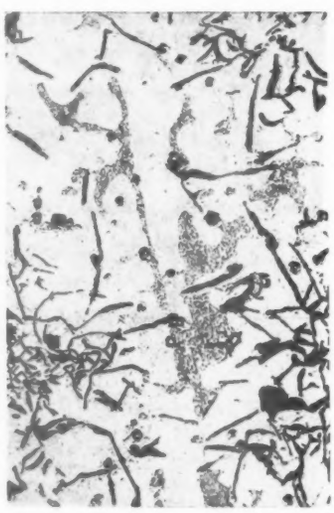

FIG. 10.—CHROMIUM 2.4 PER CENT., SILICON 10.3 PER CENT. (T.C 1.67 PER CENT., MN 0.9 PER CENT., P 0.05 PER CENT.).

The 2.4 per cent. chromium has caused a certain amount of graphite to be replaced by white iron eutectic, which is finely dispersed.

FIG. 11.—CHROMIUM 5.6 PER CENT., SILICON 9.9 PER CENT. (T.C 1.66 PER CENT., MN 0.9 PER CENT., P 0.05 PER CENT.).

More graphite has been replaced by white iron eutectic, which is not so finely dispersed as that in Fig. 10.

Photomicrographs are of 1.2-in. diameter sand-cast bars, etched in alcoholic picric acid and at 200 diameters magnification.

hardening and oil-hardening properties of six of these irons are shown in Fig. 4 (A to F). The tests were carried out in the same manner as those previously reported.[1]

The curves in Fig. 4 (A and B) are for 0.6 per cent. chromium irons containing 2.7 per cent. and 3.5 per cent. silicon respectively. It will be noted that at 800 deg. C. the irons were below the critical temperature, while at 900 and 1,000 deg. C. they were above, although at 900 deg. C. less carbide went into solution than at 1,000 deg. C., and consequently less oil-hardening was produced. The rise in hardness on air-hardening is due to the retention of pearlite, in place of the ferrite formed on slow cooling in kieselguhr.

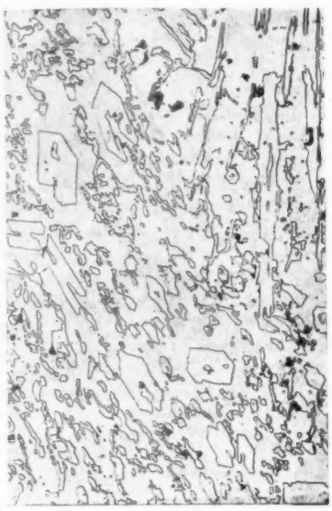

FIG. 12.—CHROMIUM 13.4 PER CENT., SILICON 9.4 PER CENT. (T.C 1.96 PER CENT., MN 1.0 PER CENT., P 0.05 PER CENT.).

Practically all the graphite has been replaced by white iron eutectic, which is more coarsely dispersed than that in Fig. 11. The alloy contains more carbon than the eutectic composition, and hexagonal crystals of primary carbide are visible.

The curves in Fig. 4 (C and D) are for 5 per cent. silicon irons, with chromium contents of 0.9 and 1.2 per cent. respectively. With this higher silicon content and consequently higher critical temperature, only a little carbide went into solution at 900 deg. C., but more at 1,000 deg. C., with the production of hard martensite on oil-hardening, and of certain amounts of pearlite instead of ferrite on air-hardening. The irons shown in Fig. 4 (E and F) have still higher chromium contents, and these further raise the critical temperature.

APPENDIX

EXPLANATION OF TABLES

In the tables included in this Paper, the following abbreviations have been used – = not estimated; * = mottled or white fracture on *visual* examination, and un. = unmachinable.

Analyses.—In the case of a series of irons in which only the special element was increased, the elements total carbon, silicon and manganese were usually only estimated on the first and last 1.2-in. bar of each series. If there was much difference between such analyses, the intermediate bars were then also analysed. Sulphur was always about 0.03 to 0.04 per cent. and was only occasionally estimated.

The chromium and silicon percentage contents of the bars (Series A to I) were as follow:—

SERIES A.—Chromium 0.67 (intermediate) 0.56
Silicon 1.64, 2.42, 2.67, 3.53, 4.20

SERIES B.—Chromium 0.51, 0.81, 1.78
Silicon 2.73 (intermediate) 2.38

SERIES C.—Chromium 0.56, 0.87, 1.16, 1.66, 3.46
Silicon 5.04 (intermediate) 4.90

SERIES D.—Chromium 2.33, 4.16, 6.46, 8.85, 15.10
Silicon 5.86 (intermediate) 4.96

SERIES E.—Chromium 0.37, 1.75, 6.43, 7.29, 7.78
Silicon 10.32 (intermediate) 6.33

SERIES F.—Chromium 0.63, 2.46, 5.65, 7.13, 7.99
Silicon 10.59 (intermediate) 9.50

SERIES G.—Chromium 7.06, 9.79, 11.81, 12.60, 13.47
Silicon 10.32 (intermediate) 9.43

SERIES H.—Chromium nil nil nil nil nil
Silicon 1.16, 1.65, 2.12, 2.94, 3.90

SERIES I.—Chromium nil nil nil nil nil
Silicon 4.46, 5.86, 6.06, 6.62, 9.16

Repeated Impact.—Repeated impact tests were carried out on 0.875-in. bars, machined down to the standard-size test-bar, which is about 0.4-in. diameter at the groove. The results are given as the number of blows to fracture, using a 4.8-lb. blow, falling from a height of 1.2 in. at the rate of 84 blows a minute.

TABLE VIII.—*Chemical Analyses and Mechanical Properties, Series H.*
(Results Collected from Different Melts.)

Silicon	Per cent.	1.16	1.65	2.12	2.94	3.90
Manganese	,,	0.85	1.02	1.04	1.07	1.07
Total carbon	,,	3.14	2.99	3.07	2.97	2.54
Combined carbon	,,	1.83	1.03	0.77	0.75	0.66
Phosphorus	,,	0.03	0.03	0.30	0.03	0.30
Transverse strength, Tons per sq. in.	1.2 in. dia.	36*	41	35	33	32
	0.875 in. ,,	35*	37	36	34	33
	0.6 in. ,,	33*	38*	37	33	31
	0.4 in. ,,	29*	36*	36*	30*	41
Deflection, Inches on 14 in.	1.2 in. dia.	0.09	0.25	0.17	0.19	0.15
	0.875 in. ,,	—	—	—	—	—
	0.6 in. ,,	—	—	—	—	—
	0.4 in. ,,	—	—	—	—	—
Tensile strength	Tons per sq. in.	Un.	23.9	22.1	18.9	20.9
Brinell hardness No.		360	231	237	213	224
Repeated impact (No. of blows)		Un.	4,666	1,075	1,546	474

TABLE IX.—*Chemical Analyses and Mechanical Properties, Series I.*
(Results Collected from Different Melts.)

Silicon	Per cent.	4.46	5.86	6.06	6.62	9.16
Manganese	,,	1.05	1.34	0.92	1.37	1.25
Total carbon	,,	2.71	2.19	2.74	2.15	1.90
Combined carbon	,,	0.17	0.35	0.16	0.17	0.17
Phosphorus	,,	0.30	0.03	0.30	0.03	0.04
Transverse strength, Tons per sq. in.	1.2 in. dia.	25	22	8	17	12
	0.875 in. ,,	26	23	13	22	14
	0.6 in. ,,	24	36	14	26	15
	0.4 in. ,,	35	23*	20	18*	8
Deflection, Inches on 14 in.	1.2 in. dia.	0.15	0.12	0.12	0.11	0.08
	0.875 in. ,,	—	—	—	—	0.09
	0.6 in. ,,	—	—	—	—	0.13
	0.4 in. ,,	—	—	—	—	—
Tensile strength	Tons per sq. in.	12.8	15.6	6.4	11.4	5.8
Brinell hardness No.		166	213	152	238	235
Repeated impact (No. of blows)		184	13	1	1	1

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[3] L. Northcott, Bulletin, B.C.I.R.A., April, 1927, and January, 1928.
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[5] Young, H. J. Institute of Marine Engineers, 1938, vol. 1. Part 12, 297–310. British Patents 495,475, 495,819, and 495,820 of 1938.

The Balanced-Blast Cupola and Fluidity

(*Continued from page* 134.)

After contributions to the discussion from MR. GEORGE URE and MR. JAMES AITKENHEAD, the PRESIDENT summarised the contributions. He thought it would be generally agreed that the balanced-blast cupola was better than the normal type. It certainly was a success at Carron, and one figure he often quoted usually caused surprise in foundry circles. The cupolas at Carron operated at a coke ratio of 15 to 1, while other foundries thought they were doing very well with 10 or 11 to 1 ratio.

He appreciated the fact that both Mr. Buchanan and Mr. Tyrie had a good word to say about sulphur. Personally, he had never met a case where sulphur could be blamed, but the statement that sulphur was detrimental in cast iron was so general that he had been afraid to say so until that evening! He did not see why it should not be present in reasonable qualities. Even chromium was equally detrimental for certain applications.

Mr. Donaldson concluded his remarks by proposing a hearty vote of thanks to Mr. Buchanan.

Study of Powder Metallurgy

Stevens Institute of Technology, Hoboken, N.J., announces the organisation of a division in powder metallurgy, and the appointment to its faculty of Mr. Gregory J. Comstock as associate professor of powder metallurgy, and of Mr. Claire C. Balke as assistant professor of powder metallurgy. The project is sponsored by a number of industrial concerns actively engaged in the production of products made by the methods of powder metallurgy. The division will present advanced instruction and carry out fundamental research. A research laboratory is now being equipped.

Heath's Contribution to the British Steel Industry

By the discovery one hundred years ago of a process of making cast steel by the use of oxide of manganese, Josiah Heath raised the annual production of this metal in Sheffield from 3,000 to 100,000 tons. Thus another chapter was added to the long and eventful history of the British steel industry. The Romans began it with their crude and wasteful hill-top furnaces. Through successive centuries smelting was practised along more or less identical lines until, according to tradition, Dud Dudley in 1620 demonstrated the practicability of substituting coal for charcoal fuel, and paved the way for a revolution in production.

Dud was in advance of his time. His contemporaries and rivals could see in his discovery only "a dangerous innovation" and menace to their own markets, and every opportunity was used for exciting prejudice against him.

In the end a mob of rioters, instigated by the charcoal ironmasters, invaded his works and smashed his machinery. Worried by lawsuits, and eventually overwhelmed by debts, he was seized by creditors and sent to London.

A Chemical Curiosity

The idea of using coal was taken up by others, notably Abraham Darby, of Coalbrookdale, and step by step improvements in manufacture were effected, all helping to give pre-eminence to British iron, and swell the volume of national employment in the metallurgical industries.

Heath presents the same persistence as Dud Dudley, and there was something analagous to the experiences of the famous Staffordshire ironmaster in the vexations attendant upon his discovery.

The remarkable affinities of manganese with iron had been discovered by David Mushet, the Scottish assayer, but until Heath applied himself to the study of the problems involved in the fusion of iron with carbon, the carburet of manganese ranked only as a chemical curiosity, precariously obtained in very small quantities. By incorporating the oxide of manganese with coal tar Heath found that he was able not only to smelt with regularity, but, as Jeans reminds us, to obtain from the ore any required bulk of carburet of manganese. His next step was to investigate the perplexing and long-disputed question of the action of manganese on the qualities of steel.

Only by repeated experiments was he able to carry his quest to a successful conclusion. Yet, as it turned out, the operation required proved to be simplicity itself. All that was needed to convert inferior steel to a higher grade was the introduction of a small quantity of the alloy—less than three per cent. of the weight of the steel to be melted—into the melting pot. Steel so treated could be welded to iron with facility.

Heath's Patent

At the time there seems to have been no idea in the mind of Heath of safeguarding his invention. His chief concern was to exploit the native ores of Porto Novo, on the Coromandel coast of India, where he had established an iron foundry which was subsequently taken over by the East India Company. When he learned that a rival had sprung up in the same field of enterprise he promptly took steps to repair his omission.

In the patent he filed on April 5, 1839, he sought protection (1) for the extraction from pure native oxides and carbonates of iron "of pure cast iron without the intervention of flux or the production of cinder"; (2) the formation of cast steel by fusing the said pure cast iron with malleable iron, or metallic oxide, in such proportion as to decarburate the iron to a certain degree and by completing the decarburation in a suitable cementing furnace; (3) the use of a certain portion of oxide of manganese in the process of converting cast iron into malleable iron by puddling; and (4) the employment of carburet of manganese in preparing "improved cast steel."

Subsequently, Heath took out a further patent embodying certain improvements on his original methods. After this his efforts were directed to the simplification of the details of production, and while achieving this object he effected such economies as to justify him in reducing his licence charge by two thirds.

An Unfortunate Mistake

Already he had appointed an agent in Sheffield for the purpose of introducing his carburet of manganese to the steel trade, and by some mischance on the completion of his new investigations he forwarded to Sheffield packages of the elements of carburet instead of the carburet itself. Once again he had made the mistake of neglecting to secure his rights, and, his secret leaking out, he paid dearly for his oversight in prolonged litigation forced upon him in the attempt to check piracy.

It is related that Heath's knowledge of the use made of his formula was gained through the sight of Sheffield cutlery in which cast steel was welded to iron backs. He at once instituted proceedings, but was non-suited on the ground that the introduction of the elements in question was a new invention not covered by the original patent. In another action in the Court of Exchequer, Heath secured a more favourable verdict, but this judgment was for some reason afterwards set aside, and when the matter was carried to Chancery he again met with a rebuff, and the proceedings were eventually suspended.

Heath waited until certain law-court decisions seemed to favour a renewal of his struggle, but when he carried his appeal to the Court of Common Pleas he only met with a repetition of his first experience. A Bill of exception to the ruling of the judge was tendered in this case, and at the hearing in the Exchequer Chambers the judgment was reversed. During the progress of these proceedings Heath died, and in 1853 when his patent was about to expire his widow petitioned the Judicial Committee of the Privy Council for an extension of the rights, which was granted for a term of seven years.

End of Litigation

The change, of course, did not affect the position as regards the elements of carburet, but Mrs. Heath was not deterred from bringing an action against a Mr. Smith for alleged infringement of her husband's invention. Not only so but when judgment was pronounced substantially in favour of the defendant she applied for a new trial, which was refused. An appeal was made to the House of Lords and that body declared definitely against Mrs. Heath, and thus convinced of the hopelessness of further effort she abandoned litigation.

It is on record that Heath's discovery resulted in a saving to steel manufacturers in little more than ten years of something like £2,000,000. More important still from a national standpoint was the fact that it rendered Britain independent of the Swedish and Russian iron which had previously been imported in very large quantities.

The industries of Sheffield flourished on the new steel which could be made ideal for their

(*Continued at foot of next column.*)

(*Continued from previous column.*)

purposes by simply putting the oxide of manganese together with a little lump of charcoal into the crucible with the metal to be fused. Yet it cannot be forgotten that the triumph was secured at the price of tragedy, for Heath died broken in spirits,

Transportable Arc-Welding Set

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The transportable arc-welding set illustrated is an extremely robustly constructed and readily portable unit built by Laurence, Scott & Electromotors, Limited. The generator is of patented design, giving a wide range of current and a stable arc over the whole range. Regulation is effected by a system of magnetic saturation and leakage which avoids the necessity of working at certain settings with the magnetic circuit in an unstable condition. By this means positive and fine regulation of current is obtained, together with freedom from accidental reversal of polarity; low open-circuit voltage; and rapid voltage recovery.

Another important feature is the detachable regulator which includes a polarity reversing switch. This feature should not only be a great convenience, but also should be responsible for a considerable saving in time when welding has to be done in an awkward position and the welder cannot have the set within reach.

TRANSPORTABLE ARC-WELDING SET.

The brushgear is fixed, all current adjustment being carried out on the regulator. One handle on the regulator provides for control of current and fine adjustment. The current setting is indicated on a calibrated scale. The set is driven by a special highly-efficient squirrel-cage motor which has its rotor keyed to the generator shaft and its stator spigoted to the end bracket.

The detachable regulator is mounted above the generator and the starter above the motor. The latter is so arranged that the motor can be run in the star connection when the generator is working on light loads, so that efficiency and power factor are maintained under these conditions. The frame is mounted upon two wheels and a castor wheel.

The range of current is 8 to 200 amps. or 12 to 300 amps., according to the size of the set.

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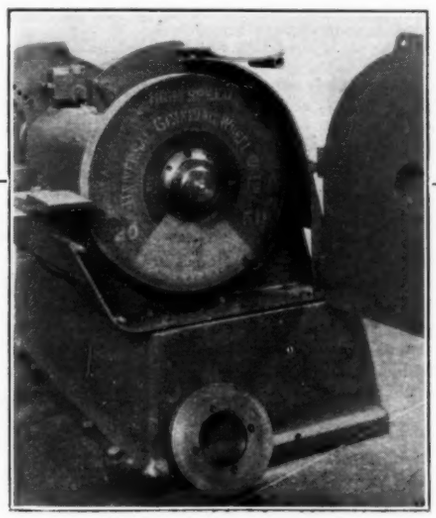
The machine complies in every respect with the latest Factory Act requirements.

Exceptionally sturdy construction and high-class workmanship throughout.

Three sizes are available, with wheels 30in.×4in., 24in.×3in., and 18in.×2½in.



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The Week's News in Brief

Trade Talk

T. BEGBIE & COMPANY, of Middleburg, Transvaal, have acquired a licence to manufacture Meehanite castings.

MR. WILLIE MURGATROYD, 5, Walker Place, Windhill, Shipley, Yorks, ironfounder, is paying a supplemental dividend of 2s. 4½d. in the £.

MR. ALFRED AUGSTEIN informs us that the name of the new company which is manufacturing in this country the products devised by his Prague company, "Kalcium," is F. & M. Supplies, Limited, 21/23, Cold Harbour, off Prestons Road, London, E.14.

THE STAFF of Carron Company's counting house held their annual dance and social in Falkirk last Friday night, when a company of about 300 were present. Among the guests were Mr. J. Ingram (commercial manager) and Mrs. Ingram, who presented the prizes.

WITH THE ISSUE dated January 31, the "Monthly Record," the official organ of the Manchester Chamber of Commerce, celebrates its golden jubilee, and the journal contains a number of special articles in addition to the usual features. A report of the annual meeting of the Engineering and Metals Section of the Chamber, held on January 12, is of particular interest. Copies of the "Monthly Record" may be obtained from Ship Canal House, King Street, Manchester, 2, price 6d.

WM. DIXON, LIMITED, have offered to supply Glasgow Corporation with approximately 5,000,000 cub. ft. of gas per day from their Govan Iron Works on the south side of the city to the municipal gas department. The price quoted will mean that the gas will be obtainable, even with purification and other expenses added, at half the cost that would be required to produce it in the municipal gasworks. The Gas Committee has now agreed that the convener, sub-convener, and manager should discuss the proposition with representatives of Wm. Dixon, Limited, with a view to adjusting terms of agreement.

WAGES of ironworkers in Scotland are to remain unaltered for the next two months as the result of a finding by the Scottish Manufactured Iron Trade Conciliation and Arbitration Board. The report of the auditors for November and December shows that the average net selling price at works of manufactures taken into consideration was £12 17s. 2.82d. per ton. This would mean an increase of 2½ points in the sliding scale, but as the scale stands at 65 per cent., due to the agreement made in November, there will be no change in the wages, and the scale will continue to operate at 65 per cent., with a minimum addition to the lower-paid men.

A JOINT MEETING of the Sheffield Society of Engineers and Metallurgists and the Sheffield Metallurgical Association, together with local members of the Iron and Steel Institute, will be held on Tuesday, February 20, at 7.30 p.m., in the Grand Hotel, Sheffield. The meeting will be presided over by Dr. W. H. Hatfield, F.R.S., Vice-President of the Iron and Steel Institute. The following Papers, which will be introduced by the authors, will be discussed:—(1) "Oxygen Determinations on a Series of Bath Samples taken from an Acid Open-Hearth Furnace (Cast E14473)," by Dr. G. E. A. Bramley, Dr. W. R. Maddocks and Mr. G. Tateson (Section III of the Eighth Ingot Report); (2) "Tensional Effects of Torsional Overstrain in Mild Steel," by Prof. H. W. Swift (Iron and Steel Institute Autumn Meeting Paper, 1939); (3) "A Study of a Nickel-Chromium-Molybdenum-Vanadian Steel Ingot," by Dr. W. H. Hatfield, F.R.S. (Section V of the Eighth Ingot Report). It is proposed to have an informal meal at the Grand Hotel prior to the meeting, at 5.45 p.m. for 6.0 p.m., the cost of which will be 5s. per head (excluding wines). Notice of intention to attend the meeting should be sent to Mr. L. Rotherham, Brown-Firth Research Laboratories, Princess Street, Sheffield, not later than Saturday, February 17.

WITH THE APPROVAL of His Majesty's Government and of the French Government, arrangements have been made for a meeting between British and French industrialists for the purpose of discussing economic and commercial questions of common interest. The Federation of British Industries has invited the Confédération Générale du Patronat Français to send a small delegation to London, and this invitation has been accepted. It will be the object of the meeting to discuss the views of the industries of both countries on the following points:—(1) The means by which British and French industry can best co-operate during the war for the attainment of the common objective, and for the solution of any difficulties which may confront them, and (2) means of collaboration by which after the war the industries of the two countries could jointly contribute to an orderly change-over from war to peace conditions and to the creation of a more sound and stable world economic system. If, as is confidently expected, it is found that there is agreement on points of principle, it will be the object of the meeting to encourage conversations between individual industries in the two countries, in order that practical effect may be given to the principles upon which agreement has been reached.

Obituary

MR. ROBERT LOONEY, a former iron-ore mine manager, died at his home at Frizington, Cumberland, at the age of 77.

THE DEATH occurred recently of Mr. William Hunter, a departmental manager of the Govan Branch of Harland & Wolff, Limited.

MAJOR C. A. VALENTINE, manager for 20 years of the Oldside Ironworks, Workington, of the United Steel Companies, Limited, has died, aged 61.

THE DEATH has occurred of Mr. L. A. Whitham, who was formerly in partnership with the late Mr. James Yates, as ironfounders, in Livesey Street, Padiham, Lancs. He was 64 years old.

MR. JAMES WATKINS, head of the firm of James Watkins & Company, machinery manufacturers, Helena Street, Birmingham, died recently, at the age of 83. At the age of twenty he started business as a maker of machines for the production of nails and staples and for wire bending, which he had carried on ever since.

MR. JOSEPH ELLIS, one of the pioneers of the West Cumberland iron and steel industry, has died at Keswick in his 90th year. Mr. Ellis, who was born at Mossley, was the first managing director of the Workington Hematite Iron & Steel Company. He retained his connection with the firm until 1920, when the firm was taken over by the United Steel Companies, Limited. Mr. Ellis was appointed a director of the Moss Bay Hematite Iron & Steel Company in 1880.

PROF. SIR GILBERT THOMAS MORGAN, F.R.S., who died in London recently, was one of the foremost exponents of high-pressure chemistry in this country. He was Director of the Chemical Research Laboratory, Teddington, from 1925 until his retirement two years ago. While there he devised apparatus by which experiments could be carried out under 3,000 atmospheres. His work in organic and inorganic chemistry, and in the study of the rarer metals, was of first importance. His application of scientific methods to industry was recognised last year by the award to him by the Society of Chemical Industry of the Society's medal—the highest honour the industry can bestow.

WE REGRET to announce the death of Mr. W. F. C. McClure, assistant general manager of Stewarts and Lloyds, Limited, at the early age of 48. Mr. McClure was educated at Fettes and Trinity College, Oxford, where he took his B.A. degree. From the University he went straight into the Army, joining the Argyle and Sutherland Highlanders in 1914. He served throughout the war with this regiment, gaining the Military Cross with bar and being twice wounded. By the time the war ceased, he was Lt.-Colonel of his battalion. He joined Stewarts and Lloyds in 1920 and passed through a course of intensive training in all branches of the firm's activities, spending five years at the Tollcross, Phœnix and Alder works. After spending five years with the sales department, he joined the board of the company in 1930, as director in charge of sales. He was for some time busily engaged with the creation of the Corby Works and was active in the promotion of the International Tube Cartel, which functioned so well for many years. He was the principal British representative and it was mainly due to his foresight that a number of the agreements were brought into being. Mr. McClure's chief recreation was golf, and he was captain of the Oxford University team in 1914. He was well known in Scottish golfing circles.

Personal

SIR ALEXANDER MACKENZIE LIVINGSTONE has been elected President of the Machinery Users' Association.

MR. GORDON P. HOYLE has been appointed works manager of Parker Foundry (1929), Limited, Derby.

DR. A. L. NORBURY, since 1927 Senior Metallurgist on the staff of the British Cast Iron Research Association, has taken up an appointment with the Research Department at Woolwich.

MR. G. J. JACKSON, managing director of the Woodhall Duckham Company, has returned to this country after a visit to South Africa, where he made arrangements for putting in hand the construction of the large installation of coke ovens and by-product plant, the order for which the company recently received from the South African Iron & Steel Industrial Corporation, Limited.

Contracts Open

Bedwellty, February 20—Castings, lead pipe, stop taps, bib taps, ferrules, etc., for 12 months from April 1, for the Urban District Council. Mr. Dan H. Price, surveyor, Fire Station Offices, Abergargoed.

Bromley Cross, February 24—Cast-iron gulley grates and manhole covers for the year ending March 31, 1941, for the Turton Urban District Council. The Surveyor, Council Offices, Bromley Cross, near Bolton, Lancs.

Leek, March 2—Sanitary pipes and gullies, cast-iron manhole covers, malleable step irons, cast-iron gullies and frames, for 12 months ending March 31, 1941, for the Highways and Plans Committee. Mr. J. A. Gilchrist, surveyor, Town Hall, Leek.

London, N., February 27—E.h.t. and l.t. paper and rubber cables; cast-iron pipes, iron castings; transformers (air and oil cooled); steel, iron, etc., for the Islington Borough Council. Mr. W. Eric Adams, town clerk, Town Hall, Upper Street, London, N.1.

Marple, February 21—Cast-iron pipes and specials, wrought-iron steam tubing and fittings, I.G.E. red coated; rubber- and paper-insulated cables, during the year ending March 31, 1941, for the Urban District Council. Mr. J. K. Law, gas and electricity manager, Gasworks, Marple Bridge, near Stockport.

Nottingham, February 23—Iron castings, gullies, etc., for the Works and Ways Committee of the City Council. Mr. R. M. Finch, city engineer, Guildhall, Nottingham. (Fee 5s., returnable.)

Port Talbot, February 19—Pipes, valves, castings, galvanised goods, etc., for 12 months from April 1, for the Borough Council. The Borough Surveyor, Municipal Buildings, Aberavon-Port Talbot.

Prestwich, February 20—Iron castings for 12 months from April 1, for the Corporation. Mr. Handel Kay, borough engineer, Town Hall, Prestwich.

Forthcoming Events

FEBRUARY 16.

Institution of Mechanical Engineers:—Annual general meeting, and Presidential Address by E. Bruce Ball at Storey's Gate, St. James's Park, London, S.W.1 at 2.30 p.m.

FEBRUARY 17.

Sheffield Society of Engineers and Metallurgists:—Joint meeting with Institution of Mechanical Engineers (Yorkshire Branch). Thomas Hawksley Lecture: "Review of 40 Years' Development in Mechanical Engineering Plant for Power Stations," by Sir Leonard Pearce, at University, St. George's Square, Sheffield, at 2.30 p.m.

FEBRUARY 20.

Sheffield Society of Engineers and Metallurgists:—Joint meeting with Sheffield Metallurgical Association and local members of the Iron and Steel Institute, at Grand Hotel, Sheffield, at 7.30 p.m. (For details see this page.)

FEBRUARY 21.

Manchester Metallurgical Society:—"Metallurgy and the Engineer," Paper by L. E. Benson, at Engineers' Club, Manchester, at 6.30 p.m.

FEBRUARY 23.

Manchester Association of Engineers:—"Development in Design of Boilers and Boiler-House Auxiliaries." Paper by A. Pollitt, at Engineers' Club, Manchester, at 7.15 p.m.

Institute of British Foundrymen

FEBRUARY 17.

East Midlands Branch:—"Grey Iron Problems." Paper by B. Hird at Loughborough College, Loughborough, at 2.30 p.m.

FEBRUARY 24.

Falkirk Section:—"Notes on the Production of Engineering Castings." Paper by A. Marshall, at Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

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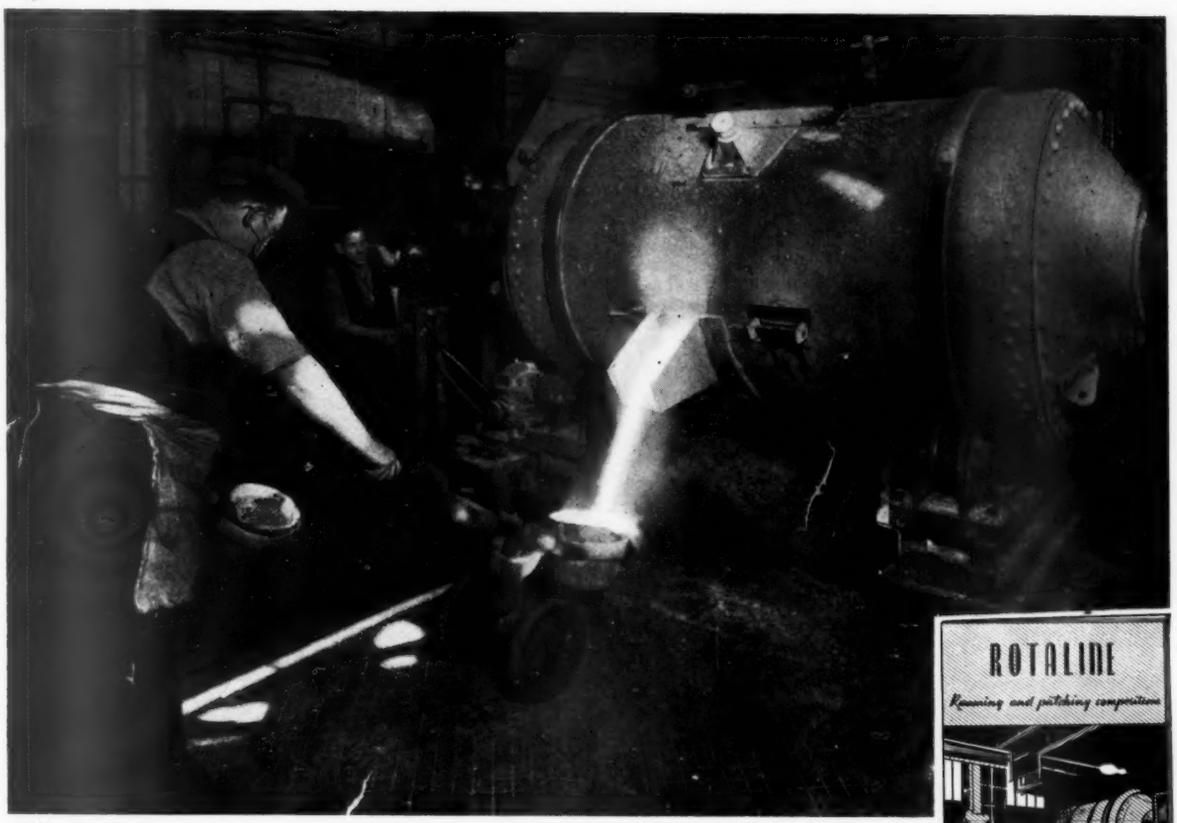

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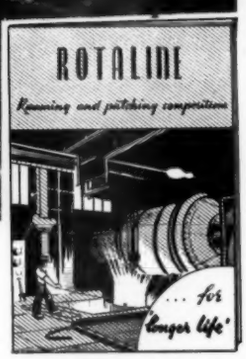

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Raw Material Markets

As was expected would be the case, the effect of the recent advances in prices of iron and steel has been negligible, in so far that the demand remains as insistent as ever. The rise of 3s. per ton in the price of pig-iron is generally considered to be very reasonable and a bigger increase would not have been thought out of hand, as the rising costs of production are everywhere appreciated. Better that the selling price be regulated according to costs of production stage by stage than that prices be increased substantially at any one time. The new scale of prices is not due to expire at a fixed date, the Control reserving the right to make any alteration in the schedule which may be dictated by the trend of events. Only small tonnages of iron and steel are as yet being released for shipment purposes, but the Government is scrutinising the position carefully and no opportunity will be lost to expand the foreign trade.

Pig-Iron

MIDDLESBROUGH—Applications for licences to secure fresh supplies of pig-iron continue to be made freely and there has been no falling away in this respect since the price was advanced by 3s. per ton. Foundries in the Cleveland area are procuring satisfactory deliveries from the Midlands, where their full requirements must now be obtained, the production of local iron being still suspended. Licences are issued only to meet consumers' carry needs and no user is permitted to replenish his stocks in excess of his week-to-week supplies. As regards the state of founders' order-books, some concerns are not yet fully employed, but, on the whole, satisfactory employment is being found for local plant.

Stocks of East Coast hematite at the producing end were recently built up, owing to transport difficulties, but these are now being drawn upon and consumers are taking delivery of large tonnages. Users, however, cannot obtain supplies over and above those needed for the prosecution of current work. Many users doubtless would appreciate the opportunity to safeguard themselves against a further rise in prices, which, in the circumstances, cannot long be delayed, but no opportunity of speculative buying now presents itself. The market accepted the recent increase with equanimity, it being realised that only a portion of the higher output costs has as yet been shouldered by the consumer.

LANCASHIRE—Foundry iron is still in heavy demand, and deliveries are being made to the consuming works satisfactorily in most instances. For delivery in the Lancashire zone the current price for Derbyshire and Staffordshire No. 3 iron is 116s., less 5s. per ton rebate, with forge iron at a reduction of from 1s. to 3s., according to the class of user. Increased demand for rain-water goods of late has improved the lot of the light-castings industry to some extent, although this department is still unable to report full order-books. Jobbing foundries, too, in many cases could accept additional orders. Most other consuming works are very busy, as is shown by the insistent demand for iron. West Coast hematite, at 135s. 6d., less 5s. rebate, is well taken up.

MIDLANDS—Light-castings foundries seem to be making some progress in their efforts to secure more Government work, but many of them are still short of employment. Fair deliveries of high-phosphorus iron are being made to this trade, but the chief demand in this area at present is for low-phosphorus iron and hematite, both of which are heavily taken up by the engineering trades. The requirements of firms on Government contracts are, of course, the primary consideration of the Control authorities when apportioning deliveries, but when a good case can be made out for other users sympathetic consideration is assured. The export trade is having to be neglected rather badly, but it is hoped to give increased attention to the overseas trade in due course.

SCOTLAND—Users have shown little concern over the recent advance in the price of pig-iron; their aim is to procure supplies, the price paid being of secondary importance. On the whole, good deliveries of pig-iron are being made. There is some delay at the steelworks in obtaining adequate supplies of basic iron, but it must be admitted that the pressure is phenomenal. Short time at the light-castings establishments still prevails, although conditions are steadily improving.

Coke

The situation with regard to supplies of foundry coke is satisfactory, many of the larger consumers having accumulated substantial reserves. The price of Durham best coke is 53s. per ton, delivered to Birmingham and Black Country stations, although this is not a firm figure on which to enter into forward transactions, new contracts being subject to a rise-and-fall clause. Durham makers of blast-furnace coke have recently advanced their price by 2s. 6d. per ton to 31s. 8d., f.o.t. This increase represents a concession on the part of the makers, for they might have secured a bigger increase under the sliding-scale agreement.

Steel

The requirements of steel in connection with Government defence projects continue to expand, and works are returning very commendable outputs. Many users would willingly extend their orders, but producers are committed as fully as they care to go at present and will thus undertake only the more urgent delivery specifications. All fresh business is, of course, done through the Iron and Steel Control, which is keeping in close contact with the market. It is possible to do a certain amount of export trade, but this section is still quiet, owing to the magnitude of home business.

Scrap

Iron and steel scrap remains in very strong demand, especially those grades suitable for steelworks' use. All available supplies are absorbed without delay, and the potential requirements of the steel industry are engaging the attention of the scrap trade organisation to the full extent. High hopes are centred on the results of the campaign to bring out the large tonnages of scrap lying idle in various parts of the country, and the tonnages already obtained in this way are very gratifying.

Metals

The Minister of Supply has made a Direction (No. 2) under the Control of Non-Ferrous Metals (No. 5) Order, 1939, increasing the maximum prices for copper, lead and zinc by the following amounts where deliveries of metal are called for in lots of less than 4 tons:—Copper: For lots over 2 tons and under 4 tons £2, 1 ton up to and including 2 tons £3, 1 ton and under, £4; lead and spelter: £1, £1 10s., and £2 respectively. The Direction comes into force on February 19, and the Controller of Non-Ferrous Metals will charge these extras in contracts made by him on and after that date.

A firmer tone has been evident in the tin market during the past few days, and buyers have shown more interest at higher prices. This has been brought about to a large extent by the possibility of a substantial cut in quotas for the second quarter of the year. The International Tin Committee meets on February 26. Thus, there has been a resumption of speculative interest in London, while, for a similar reason, the United States market has also become slightly more active. It is obviously in the interests of Great Britain to build up and maintain tin stocks at a substantial level during the war, and consequently reduced quotas are scarcely likely to find much support here, but Dutch interests especially are understood to be agitating for lower production limits.

Commenting on the position of the American tin market, a recent report by C. S. Trench & Company, Inc., of New York, points out that "the principal tin producers and their respective governments may rightly complain that the actions of American buyers make it almost impossible properly to regulate supplies and maintain orderly conditions in the industry. Despite the most definite assurances that sufficient tin would be forthcoming in time to meet all requirements, buyers by their panicky and impatient actions last autumn defeated the attempts of the British Government, at great cost to its own nationals, to keep prices at reasonable levels, and now that the large supplies which we begged for are at hand, and now that a reasonable price level has been restored, the buying interest has almost vanished."

Metal market prices for tin were as follow:—*Cash*—Thursday, £238 5s. to £238 10s.; Friday, £238 10s. to £239; Monday, £241 5s. to £241 10s.; Tuesday, £242 5s. to £242 10s.; Wednesday, £243 to £243 5s.

Three Months—Thursday, £238 to £238 5s.; Friday, £238 10s. to £238 15s.; Monday, £241 to £241 5s.; Tuesday, £242 to £242 5s.; Wednesday, £242 15s. to £243.

Following our statement in last week's issue regarding shipments of United States copper for Germany in a Soviet vessel, a New York report states that shipments of war materials, particularly metals and minerals, to Russia, presumably for use in the war against Finland and possibly for re-export to Germany, are attracting increasing attention in the United States. Some of these American exports are being taken across the Pacific from west coast ports; others are being transferred to Russian cargo boats in the Mexican port of Manzanillo. Further consignments of copper and Mexican lead will be taken across the Pacific by Russian cargo boats.

Certain non-priority users of spelter are not receiving all the metal that they would wish for, but, on the whole, deliveries are not unsatisfactory. Empire producers are well situated to supply the wartime requirements of the United Kingdom, but naturally the Control authorities are anxious to guard against any possible interruption of shipments. Similarly with lead, the needs of the firms engaged on Government contracts are being given first consideration.

Heavy Industries' Activity

Presiding at the annual meeting of Williams Deacon's Bank, Limited, Mr. C. P. Dewhurst said that they had excellent reports from their branches in the Sheffield area. Production of iron and steel had maintained a high level during the year, while foundries, forges, and machines had been working to their utmost capacity, and with full order-books these conditions seemed likely to be maintained. It was worthy of note that, with the co-operation of the British Iron and Steel Federation, complete control of the whole industry was established at the outbreak of war, and that since then, in spite of the rise in cost of imported materials, prices in general had only been increased by some 10 per cent. Employment in the colliery districts of South Yorkshire seemed to have been fairly steady throughout the year, though their large export trade had suffered considerable dislocation owing to war conditions. Improvement, however, was expected here. They had good reports from Bolton of increased activity in engineering and substantial improvement in its textile trade, which, if maintained, would be most welcome, as a large proportion of the output from this district was for export purposes.

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